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EDITORIAL NOTES.

Ilkeston Holder and the Factor of Safety.

A HOME OFFICE inquiry into the causes of, and the circumstances surrounding, the Ilkeston gasholder disaster has been held by Mr. A. G. Drury, M.Inst.C.E., one of the Engineering Inspectors of the Local Government Board. We do not envy Mr. Drury his task in pronouncing judgment on a matter upon which the earnest convictions and opinions of the experts he has had before him are, in all matters of detail, in, if not precise, close agreement, and which convictions and opinions are opposed to any positive pronouncement as to a cause or causes. During the part of the day preceding the accident, the atmospheric conditions were not abnormal; the tensile strength of the steel of which the wrecked tank plates were composed has been put to independent tests, and, on all hands, there is agreement that it was ample; the factor of safety allowed by the contractors has the warrant of three years with this particular spiral-guided holder, under worse atmospheric conditions than prevailed the day prior to the accident, as well as the warrant of longer experience with gasholders of similar type throughout the country having the same factors of safety in their different parts. We repeat that we do not envy Mr. Drury his task, when he comes to place in parallel the views of Mr. Samuel Glover, Mr. J. Ferguson Bell, Professor Henry Adams, and Mr. R. J. Milbourne, and then attempts to draw deductions from them.

However, under the circumstances detailed in the foregoing, the conclusion seems inevitable that, owing to untraceable causes, the tank was subjected at the particular time to an abnormal combination of conditions and forces, to meet which the margin of safety allowed was not equal. From beginning to end, the evidence is inconclusive as to whether the trouble was initiated in the holder or in the tank; and it is only by the process of deduction that one, from whatever point of approach, comes to the conclusion that the initial trouble was in the holder, and that the exceptional strains thus brought to bear upon the tank proved that, under the conditions, the factor of safety did not embrace a sufficient margin to meet them. The suggestions made during the inquiry as to modifications in detail in gasholder structures do not appear to have much bearing upon the "causes and "circumstances" of this particular accident. They are useful maybe for consideration in designing holders with the view of obtaining increased strength, but for nothing else. Then the point as to whether the fracture of the tank commenced at the top or the bottom is one that has not been satisfactorily answered. It is also a matter of conjecture. But the balance of opinion is in favour of the fracture having commenced at the top. That is Professor Adams' view; it is also the view of Mr. Glover, Mr. Bell, and other witnesses. It appears to have commenced near one of the brackets, and then to have continued downwards. This further emphasizes the point that the trouble began in the holder itself; and it contributes to the view that the location at which the margin of safety was insufficient for meeting an indeterminate set of conditions, was near the top curb of the tank, though precedent had shown that the factor of safety, under severe variations of atmospheric conditions in different localities, had been ample. Mr. Glover agrees that up to the day of the accident, he, with his experience, would have had no hesitation in accepting the factor adopted in the design of the tank. But he should prefer now to make it 4 (which is also Mr. Bell's preference), instead of 3·5 or 3·75.

The findings of Mr. Drury will now be awaited with considerable technical interest. No doubt the accident and the inquiry will have some effect in revising the factor of safety for gasholder tanks. There is a disposition here and there to charge the builders of holders with having pared-down the factor with the view of competitive cheapening. There should be some care in making this charge, excepting on specific cases of default, as the factors of safety adopted by the holder builders in this country have never yet been found, so far as information goes, to be under theoretical limits, and to be added to this statement is the experience of years. At the same time, Ilkeston suggests the propriety of raising the factor of safety of the top part of an above-ground steel tank for a gasholder, in order to meet an unprecedented set of circumstances such as the evidence points to as having arisen at Ilkeston, but which may never be experienced again.

An important point was raised by Mr. Bell that has a bearing here; and it is that competent engineers should, in the making of contracts, examine for theoretical adequacy, on behalf of the purchasing party, the drawings and the specifications supplied by the contractors. He is averse to contractors acting in the dual capacity of engineers and contractors. In this matter, the contractors, through their extended experience, are better able to express an opinion on the question of the adequacy of a design than many engineers; but this does not, of course, apply to all. There is, too, another aspect of the matter. In the protection of the engineering firms themselves, there should be this examination and ratification of their drawings and specifications by a competent engineer. And knowing that there would be this inspection, there would be restraint in cutting down to minimum limits the factor of safety in order to get in a low price. They know that, in ungoverned competition, if a large margin is allowed, the price will be up, and there will be no chance of securing the work. The independent engineer would see that safety, not price, governed the acceptance of a tender, unless the contractors were tendering to drawings and specifications prepared by him. On the whole, this is the better plan, if the engineer has experience of the particular structure to be tendered for. Frequently six to a dozen drawings and specifications are prepared by various contractors, while that of an independent engineer would alone suffice, with permission, of course, for the contractors to submit alternative designs or suggestions should they think it desirable. Their experience must always be the subject of respect. But if variations are made, and before the contract is let, the weights should be carefully taken out by the engineer and compared one with another, and not allow price merely to be the arbiter in decision. If, for no other reason, we look upon this inquiry at Ilkeston as of immense importance, in that it forces upon the attention of all who have constructional work to carry out, the necessity of seeing that a "safe" factor of safety is allowed for, and that the work is executed in such a way that the factor is realized.

The Meeting of the Société Technique.

THERE was a very good attendance of the members of the Société Technique du Gaz en France on the occasion of the holding of the thirty-ninth annual congress in Paris last week. This was only in accordance with the general rule when the meetings take place in the French capital. M. Henri Marquisan, one of the Directors of the Marseilles Gas and Electricity Company, presided; and having completed his two years' occupancy of the presidential chair, he hands over to his successor, M. Auguste Boutan, the General Manager of the Lyons Gas and Electricity Company, and the Committee, the conduct of the affairs of the Society, which will soon have attained its fortieth year. The programme was not quite so full of papers as usual, nor, with a few exceptions, were they of striking importance. But there were several interesting reports by the Technical Commissions which have lately been constituted—notably one on "Coal Testing" and another on "Manufacture;" and two subjects were down for discussion without the formality of introduction by papers. As two of the communications in the printed list were not taken, it was possible to carry out a suggestion by the President that the business should be brought to a close on Thursday morning, when

the members started for an excursion, and so obviate a sitting on Friday, as was originally intended.

The papers of special interest, from a technical point of view, may be briefly noticed. First, as being upon an entirely new subject, was a communication by M. Grebel on "Comburimetry"—*i.e.*, the measurement of the air or oxygen carrying capacity of gases. The author had already expressed his views on this matter in the columns of one of our French contemporaries; and attention was called to it in the "JOURNAL." But the present was its first formal introduction to the gas profession in France. The paper deserves more than the brief indication of its scope which is given in the review of the proceedings at the meeting appearing elsewhere; and it will be dealt with more fully in an early issue. A long paper by M. Bertin, on "Heating by Radiation," dealt with a question to which much attention has lately been given, as the result of Professor W. A. Bone's labours. The equipment of small gas-works with machinery formed the subject of a communication by M. Crozet. Our old friend—or foe—naphthalene was brought before the members by M. Laurain, who is General Manager of the Technical Department of the Paris Gas Company, for the purpose of directing their attention to the apparatus devised by M. Sainte-Claire Deville for testing the quantity of this constituent in gas. The contamination of gas in holders and the removal of the bisulphide of carbon in gas were dealt with in an interesting communication by M. Guillet. The application of gas to the heating of bakers' ovens was discoursed on by M. André, whose explanation of the construction and capabilities of his oven was followed attentively. Fuller notices of the communications and reports submitted at the meeting will be found elsewhere.

Under the presidency of M. Marquisan, the Society has made good progress—technically, as shown by the reports just referred to, and financially as testified by the statement submitted by the Treasurer (M. Frère). The Committee record additional contributions to the funds by gas companies. This will give them a freer hand in connection with investigations; and it has already enabled them to create a supplementary list of awards for long service. The system of awards has always been a prominent feature of the work of the Society. It is a foreign custom; but, like some others, of a less praiseworthy character, it is becoming British in more senses than one, having, as readers of the "JOURNAL" are aware, been introduced into the Company bearing that name by its Chairman—Mr. J. Horsley Palmer—who, in his similar position in the Imperial Continental Gas Association, has had many opportunities of witnessing its beneficial effects upon gas employees on the Continent. The bare statement that the distribution of awards to meritorious workmen formed part of the proceedings at the meeting of the Société Technique last week does not convey to the reader an adequate impression of the effect produced. The few words of congratulation and the hearty hand-shake which accompany the gifts must be heard and seen to be fully appreciated. And as the workers in the lower ranks are decorated for "long and faithful service," the Committee thought they were justified in adopting a suggestion made by M. Delahaye that two of the founders of the Society—M. Albert Ellissen and M. Joseph Ancel—who are still serving upon the Committee, should each be presented with a medal. This was done, in the case of M. Ancel, at the banquet on Wednesday evening; but, in M. Ellissen's absence, it was entrusted to his son. With the record of this pleasant feature of last week's proceedings, our notice of them may be fittingly brought to a close.

Local Government Board and the Chemical Clause.

THE parliamentary position in connection with the insertion of the chemical clause in Gas Bills and Provisional Orders is getting more confusing than ever. Now the Local Government Board have thrown their departmental weight on the side of the chemical manufacturers and against the gas industry; and yet the Board do not appear to have any clear notions as to why they are doing this. A number of Local Government Gas Orders (as reported in our "Parliamentary Intelligence" last week) have been, in Confirmation Bills, before the Unopposed Bills Committee. Until this stage, no amendment in respect of the powers relating to residual products appears to have been even contemplated; and the Board have seen no reason to impose any restriction. Then suddenly came this *volte-face* when the Confirmation Bills got into Committee, and the Board asked for amending words to be introduced in order to limit the promoters to dealings in their own residuals. We ask the Board whether, on their own showing, the amendments were not altogether superfluous. The representative of the Board confessed that it was altogether improbable that the promoters of these Orders would want to embark on such a business as the working-up of the residual products of other gas undertakings. This being so, why go to the trouble to make the amendments? It is really difficult to understand the influences that are at work in this matter, which make Private Bill Authorities, Committees, and now Government Departments comply with the demands—they are so promptly acted upon that they seem more like commands—of the chemical manufacturers in this unreasonable manner. The Local Government Board do not seem to have given the subject any real consideration; for the statement was made on their behalf to the Committee that they would certainly want to reconsider the question of the councils carrying on such commercial undertakings as the working-up of residuals unless the addition was made. Why did not the Board bestow full consideration upon the question before they moved in the matter of restriction? Had they done so, it might have occurred to them that it might at some time be to the interests of a number of such small undertakings, and of the communities they serve, to pool their products, and for one of them to work them up, instead of being compelled to dispose of them to the chemical manufacturers on the terms of the latter, as dictated by their self-interest, and not by the laws of competition. Limited markets are to the disadvantage of communities; and it is the business of the Local Government Board to look after the interests of communities, and not of private trading individuals like the chemical manufacturers, who are using Parliament for their own commercial ends by compulsorily driving gas undertakings into their hands. For the best interests of communities and gas consumers, unfettered residuals markets, and the ability to work up residuals in the most profitable manner, are the wisest policies. Is it so very difficult for the Local Government Board and the Parliamentary Authorities to see this?

A New Process for Estimating Naphthalene.

To M. Sainte-Claire Deville, the gifted Engineer-Chemist of the Paris Gas-Works, and to the experimental station of the works, the gas industry is indebted for much that is original in the investigation of the problems surrounding gas manufacture and distribution, and for much that is classical information. From this source, there now emanates a new method for the estimation of naphthalene in gas; and it has had its introduction through a paper read by M. Laurain at the meeting of the Société du Gaz last week. The subject of the computation of the quantity of naphthalene in gas has been worked at by several fertile brains; and various chemical expedients have been devised, of which the Colman-Smith picric acid method is one of the most popular. But popular though it be among gas workers, it has not met with unqualified acceptance in Paris; as there the experimentalists have been giving the test a new dress of manipulatory methods and precautionary rules, with the object of securing by it an accuracy said to be not otherwise attainable. Even so, the method does not fully commend itself; and there has been search for, and an ultimate devising of, a process which will give rapid determinations as to the naphthalene content of gas without delicate operation. To effect this, chemical procedure has been discarded in favour of physical procedure. This is striking out on to quite a new line; and, indeed, it brings the test into harmony with those natural laws that govern the behaviour of naphthalene—troublesome or otherwise. The object to be attained was to devise apparatus that would permit rapid, and therefore frequent, measurements to be made; one that would not have its accuracy of determination assailed by the delicacy of operation; and one that could be used on works or on the distribution system at will, so as to obtain the required information from any part of the system through which the gas passes to reach its final destination.

The principle involved in the process is the ascertaining of the critical temperature of the gas in respect of the deposition of the naphthalene contained in it, following the principle of the Alluard hygrometer—in other words, the object served is to find the temperature to which the gas must be cooled in order to cause naphthalene to commence

depositing. Deprived of all surrounding and auxiliary conditions, the central feature consists of causing the gas to pass through a very fine passage which is heated or cooled as desired. By this means the thin thread of gas under pressure can be subject to sharp cold to the point at which the solids will be deposited and so obstruct the passage. The temperature at which the deposit occurs is the "critical" one; and it is the temperature indicated by a thermometer while the obstruction is kept constant—neither enlarging in amount nor being volatilized by the passage of the gas. This is the information that every official troubled with naphthalene and responsible for an uninterrupted supply of gas in his district requires to have placed in his possession, and it is the information with which this innovation in gas-works methods of determination furnishes him. Tables have been drawn up to show approximately the weights of naphthalene saturating gas at different temperatures; so that, when the critical temperature is found, the further information can be secured from the tables. The gas before flowing through the apparatus should at least be partially dried by passing it through chloride of calcium. Whether this is likely to have any disturbing effect upon the naphthalene is not stated; but it is quite clear, with the capillary character of the passage through which the gas is drawn, that there must be no tarry matter in the gas, and it must also be free of ammonia, in order to avoid the chance of ammonium carbonate being deposited with the naphthalene. The method is new; it is simple. Whether all said of it now that is good will be borne out in future, cannot be said until the apparatus has left its birthplace, and has been put by other hands to test under various circumstances. But the quarter of its origination is a commendation of no mean order.

Coal from America and Coal Storage.

Looking at the returns relating to the coal supplies of this country, one sees how very widely the part exported is distributed over the world; and this causes us to appreciate how extensively the outer world (as well as ourselves at home) is concerned over any such total cessation of those supplies as we have witnessed this year. British gas-making and steam-raising coals are preferred where they are economically available, or where they are the most economically available; but good reputation and consequent partiality are not sufficient to save the foreign customers of the country's coal, on such a stoppage of supply as we have witnessed this year, from turning their eyes in other directions to ascertain the possibilities of bringing other sources of good coal within their reach. It is not a question at the moment whether or not it would be economically a good thing for this country if there was a falling off in the alien custom for the chief of its natural products; but it would certainly have a good disciplinary effect upon the coal producers of this country if coal of equally good quality could be brought from elsewhere into the European markets. Home coal producers are too despotic in their methods for these to be pleasant, or to be conducive to the promotion and maintenance of amiable feelings towards them.

The question of a supplementary or competing source of supply for our foreign gas-coal trade is again brought to the front through a paper submitted to the Société Technique du Gaz by M. Masse. He considers the prospect of obtaining coal from America, just as the Gaslight and Coke Company a couple of years or so ago considered the prospect, and demonstrated the feasibility, of bringing coal into London from the Westphalian coal-fields. Westphalia is not far off, though the coal for gas making is not all that could be desired. Our European friends attest this by their free patronage of the British coal-fields. When we go further afield, however, and meditate upon other sources of suitable supply, three adverse considerations always crop up. They are the increased cost delivered through the expense of transportation; the fact that the greater the distance to be traversed between source and destination, the greater the liability to irregularity in delivery; and the desirability, with long sea distances between source and point of delivery, of having deliveries greater during the best weather for transport (when requirements for gas making are the lowest) to ensure safety during the period of maximum requirement, when the chances of delay in transport are greater through bad weather. M. Masse finds that, under present circumstances, the cost of transport of coal per ton from the coal-fields of America into France would be something like 20 frs. Such a figure makes the proposition one that is not economically feasible. But that the cost is so high is due to the fact that coal transport facilities from America to Europe have not been developed as they would be if any considerable demand arose this side of the Atlantic for American coal.

Such development of facilities would reduce transport costs; and a further difference in the over-all cost arises from the fact that the price of coal at the pithead is less in America than it is here. There is also a prospect that, through the trend of events, prices will be perennially maintained at a lower level than in this country. America possesses enormous tracts of coal-yielding territory. This alone keeps supply well in excess of the demand. In coal-getting, too, America employs machinery to a far larger extent than we do in this country. Further, America has been a country that has lagged behind in lessening the waste of its fuel by the application of economical heating methods in its manufactories. But there, again, more economical processes and applications are in the air; and savings are being effected. All these considerations point to the fact that supply threatens to outstrip demand to such an extent that America will be looking around for outlets for its surplus production, and this must result in a broadening-out into the more distant markets of the world. From the gas-making point of view, the coal is of good quality; so that on all grounds M. Masse looks upon supplies of coal from America for Europe as being one of the practical developments of the future. If any of our readers can add to the interest of this subject by communicating other information concerning it, there will be hearty welcome.

A cognate consideration is the one of storage on gas-works—a matter that has been much to the fore recently, likewise through the protracted coal strike, with the result that there seems to be general (though not complete) agreement that the managerial policy and rule in this regard will have to be revised. M. Masse has been asking himself how best the increased storage can be obtained without making too great a sacrifice. Trials at Newport, as well as in the United States and in Germany, have proved that coal can be stored under water for long periods, and not depreciate to any material degree. M. Masse therefore proposes that gas-works should make part of their stock, as it were, a permanent one under water, and so reduce the stock above ground, where its exposure, to greater or less extent, according to the physical characteristics of the coal, causes it to depreciate. This depreciation necessitates constant handling and use, and reinstatement by fresh coal. M. Masse is of opinion that the economy resulting from the small quantity of exposed stock to be dealt with would compensate for the expense of providing the underground storage for the stock allowed to be permanently at rest under water until emergency makes peremptory demand upon it. Of course, the argument is bound to be raised that the coal will absorb water, and that the effects, when the coal is used, will be found in the retorts, in reduced temperatures, and in the fuel account But the simple answer to this is that the coal is not required for continual use, but is merely a permanent reserve against emergency. No one would think of storing coal under water, except for the special purpose of preserving it against the worst of emergencies.

Wrought Iron and Sulphuretted Hydrogen Formation

An article contributed to our columns this week by Mr. J. G. Taplay, and a paper by M. Guillet presented to the Société Technique du Gaz, have a remarkable affinity; and between them these masters of analytical and research work have thrown considerable light on one of the many phenomena that cross the experience of the technical gas man, though M. Guillet set out on his work with the intention of testing and supporting or challenging the finding of Mr. Taplay, some six years since, that sulphuretted hydrogen could be formed by bacterial processes in the tank water of gasholders. The results of the investigations of the two workers—the one in London, and the other in France—bring them into very close accord as to causes that may produce sulphuretted hydrogen in the case of gas that has divulged a good character in this respect on its exit from the purifiers. Their investigations contribute a solution of cryptic experiences that at times the gas chemist or the gas engineer have had, and which may have completely "floored" them so far as advancing any rational reason for the occurrences go. The contributions of the two investigators also warn that care should be exercised to prevent, if possible, the conditions

that conduce to the fortuitous formation of sulphuretted hydrogen subsequent to the completion of the purifying process. Mr. Taplay, in his article, goes somewhat farther in one direction than M. Guillet, and M. Guillet goes somewhat farther than Mr. Taplay in another direction; but they both come to practically the same main conclusions.

The investigations by Mr. Taplay were entered upon by the discovery that purified gas that passed through a wrought-iron pipe crossing the ceiling of the gas-compressor station below the Tudor Street Laboratory of the Gaslight and Coke Company gave dark sulphuretted hydrogen stains on the test-papers, while the contrary was the case with a tin-lined pipe and another wrought-iron pipe that was not subjected to the same degree of temperature as the one supported by the ceiling of the compressor-room. There was an interesting problem for solution here; and Mr. Taplay's thorough research, checked at every stage, leaves no room for doubt that he has arrived at an interesting solution, and one that is very valuable in respect of both the information and the caution that it conveys; while M. Guillet's investigations into the formation of sulphuretted hydrogen in gasholders corroborate those of our own contributor. From these distinct investigations, it is quite clear that, given a wrought-iron pipe or other wrought-iron vessel exposed to a high temperature, with moisture and carbon bisulphide in the gas, one has all the conditions necessary to the production of sulphuretted hydrogen. M. Guillet's experiments lead him to the conclusion that changes are brought about by two connected actions—the one catalytic and the other electrolytic. Mr. Taplay also finds that there is sufficient variation in the composition of the metal to cause local electric currents to be set up when the metal is heated. It is quite possible that feeble currents are always present even when the metal is at atmospheric temperature, and that the heating intensifies the currents. There, again, we have the two experimenters, working separately and some distance apart, showing that electric current has a part in the production of the sulphuretted hydrogen in purified gas.

We come to the practical application of the elucidation of the phenomena. It is obvious that wrought-iron pipes conveying gas should not be run in proximity to any source of excessive heat. For example, as Mr. Taplay points out, instances are not unknown where gas transmitted through wrought-iron test-pipes from purifiers has given a sulphuretted hydrogen indication, while a test-cock on the cover of the purifier gave no indication of the presence of the impurity. The proximity of steam-pipes, or other means of raising the temperature in a wrought-iron test-pipe, is sufficient to cause the formation of sulphuretted hydrogen. The precaution of keeping wrought-iron gas-pipes clear of any heat-raising source is one that can, as a rule, be easily arranged; and the importance of doing this in all situations is patent from these experiments. On the other hand, M. Guillet would attack the problem at the point of purification by reducing one of the factors—carbon bisulphide—necessary to the casual production of sulphuretted hydrogen in the manner described. Oxide of iron has, the higher the temperature, a greater absorbing power for carbon bisulphide; and this fact, combined with longer contact of the gas with the purifying material, would, in his opinion, be advantageous. But this would not relieve the necessity for the precautions advocated by Mr. Taplay, inasmuch as the complete removal of carbon bisulphide is not economically practicable; and so long as there is any in the gas, given the remaining factors of high temperature and moisture, with the slight electrolytic action, the trouble would no doubt arise, though, of course, in lessened degree with the reduction of the carbon bisulphide. The article and paper lead us into quite a fresh train of thought in connection with the pollution of gas by chance conditions.

A Trip Committee and a Begging Letter.

THERE is before us a circular-letter which has been addressed to firms of contractors by the Trip Committee of the employees of a large, and not impecunious, Corporation in the North of England, and which circular-letter merits condemnation in the severest terms. The municipal employees of the county borough concerned are proposing—the proposal is an excellent one—to have their annual excursion early in July; and the place selected for it is Llangollen. The excursion, the circular-letter states, is "under the patronage "of the Mayor and Corporation." A "Trip Committee" has been formed; and in order to provide them with funds, the circular-letter alluded to has been sent to contractors who have business relations with the Corporation, soliciting from them "generous" financial support for the trip. The fact that the appeal emanates from the employees of a county borough of some position is bad enough; but the suggestion to those to whom is addressed the begging appeal for money for such a purpose as this—that their donations should be "generous"—is nothing but a piece of sheer impudence. It is also stated that remittances will be "gratefully acknowledged;" and thanks are tendered in anticipation of the favours that it is hoped the appeal will produce. Further, the assurance is given that any donation the recipient may deem fit to make will be used entirely in the endeavour to make a pleasant and instructive outing for the employees at a cost as low as the funds at disposal will permit. There is not the slightest doubt about that. There are, however, other aspects of this matter than that of a pleasant and instructive outing for the employees of the Corporation in question, the members of which body, if cognizant of this begging from contractors on the part of their employees, ought to be ashamed of it; and, if they do not know of it, then they ought to feel the humiliation of the undignified position in which such solicitation by their servants places them.

From the point of view of the contractors, it is grossly unfair that they should be exposed to this sort of thing—especially if done with the knowledge or the connivance of the Corporation. If this sort of thing is allowed, contractors will never know where their obligations are to end. In the representations made to us on behalf of contractors, it is pointed out that, having in view the keen competition of the times, if they are to be subjected to fleecing of this kind, the engineer should insert in the contracts a line to the effect that the contracting firm is expected to subscribe to the summer outing of the municipal employees. Then the successful contractor would know where he is, and what are to be the penalties of his success, for which he would make provision in his tender. If contractors were to be preyed upon in this way by all the municipal employees of the country, the thing would become intolerable. There is another aspect of the matter. The system of solicitation under such circumstances is both vicious and immoral; and we are not sure that it is not illegal under the last Bribery and Corruption Act. An allegation could be made to this effect under specific conditions. Assuming two contracting firms supplying the same kind of plant to one corporation. In the one case, the firm make a contribution to the holiday fund of the employees; in the other case, the firm (on principle) decline to do so. Supposing something went wrong with the plant furnished by the non-subscribing contractors; supposing the men made all sorts of complaints about the working of the plant, and did not do so about that supplied by the subscribing contractors. The non-subscribing contractors could well assert that the subscribing firm were having favour shown to them, and that the subscribing contractors had, by means of their cheque, purchased the favour of the employees to the disadvantage of the non-subscribing contractors. We hope that the Corporation concerned in this matter will see to it that the impeached circular-letters are withdrawn, and that the distribution of similar appeals is not repeated. Importunate begging by municipal employees from contractors in this way is wrong, and such a pernicious system of obtaining funds ought not to be permitted by any self-respecting municipal body.

"Every Picture Tells a Story."

The South Metropolitan Gas Company, we find in a paragraph under this heading, have gravely offended the impeccable "Meteor" of the "Electrical Times"—"Meteor" who is extraordinarily particular about the quality of the "story" told by the photographs he selects for publication with the view to defaming gas, and who scrupulously overlooks those—such as the Nottingham explosion, through electrically generated gas—that would in any way disclose some of the very real activities in destructive work of electricity. This writer's complaint about the South Metropolitan Gas Company is that they have published an advertisement illustrating an electric-motor and a gas-engine, in which the rivals are not drawn to scale; the effect being that the electric-motor occupies apparently about as much space in the world as the gas-engine. But what matters this when a few feet of space

are not dearly bought by a perpetual economy. However, that is the sole offence of the Gas Company. We rather think that beneath the silly complaint (which occupies the greater part of a leading column of the paper) the real point of irritation is that the words appear above the illustrations "Why was this Electric-Motor replaced by this Gas-Engine?" But as the disproportionate appearance between the electric-motor and the gas-engine is made the ground of grievance, we would suggest to "Meteor" that he should admonish the Borough Council in whose district the advertisement was published, and advise them to abstain from the publication of mendacious pictures that are designed to belittle gas as a power agent. Long before the advertisement in question appeared, the Electricity Committee of the Borough Council concerned had put large posters about the district showing an electric-motor and on the opposite side a gas-engine the fly-wheel of which is covered with men struggling to start it, and, if we remember rightly, a child and a dog are also rendering aid. That is one of the pictorial violations of truth committed by the Electricity Publicity Committee, and circulated (among others) by the Borough Council in question. Probably the engineering knowledge of the Council's Electricity Department is so far in arrear that they have never heard of the various mechanical methods of starting gas-engines, which reduce the operation to the beautiful simplicity of the electric-motor—when the electric-motor is in running order, and there is not a cessation of the supply of current. "Every picture tells a story"—sometimes a story of the grossest misrepresentation. The Borough Council concerned started the campaign in pictorial comparisons. They have themselves to thank for the reply made. It is for them to say whether they intend to pursue the same tactics.

Parliamentary Regulation of Profit Appropriation.

If Mr. J. G. Newbigging, the Chief Engineer of the Manchester Corporation Gas Department, and Mr. S. L. Pearce, the Chief Engineer of the Electricity Department, are not commercially precisely bosom friends; they are comrades in arms on the question of the appropriation of the profits of their respective departments for the relief of the rates. It is not often the chiefs of two trading departments of a municipal body that dip deeply into the profits of the undertakings dare to speak out so plainly as Mr. Newbigging and Mr. Pearce have done on this particular topic. Manchester, however, is a city of free speech; and it is not reckoned an act of treason for the officers to hold personal views that are opposed to the policy of the civic authority. Moreover, while profit-plundering is considered a diplomatic act by a majority of the Council, there are very strong members sitting among the minority who advocate the abolition of the policy; and these combined offer a good palladium to the departmental chief officers. Mr. Pearce carried into the midst of the members of the Municipal Electrical Association last week his plea that profits made by a municipal electric or gas undertaking should be devoted to the benefit of the undertaking and its patrons, and should not be shared with those who have not assisted in making them. He has the satisfaction of knowing that those councillors who spoke on his paper, and were favourable to the retention of existing appropriation conditions, made a very poor defence of their attitude. Mr. Pearce, it will be seen from the report elsewhere in this issue, submitted some excellent points. He overthrew one by one the effete phrases, glorified by the title of principles, glibly quoted by the members of the ancient order of municipal pilferers. For example, as to the assumed title of the ratepayers to a permanent monetary recognition for security offered in their name, Mr. Pearce holds, and rightly so, that they are better protected by healthy and tangible reserve funds, in addition to the sinking fund, than by dissipating the profits in aid of the rates. Then, if good service is the main argument in support of municipal trading, he finds that the consumer may be worse off under municipal administration, with interest *plus* profit appropriation to meet, than consumers under statutorily regulated companies with limited dividends to pay on their capital. The view of Mr. Pearce is that Parliament should definitely regulate the amount of profit to be appropriated—say, 1 or 1¼ per cent. on the outstanding capital. But the mention of Parliament and regulation caused the profit appropriators at the meeting to rise in protest. They do not like the idea of Parliament interfering with them. They see the handwriting on the wall. They are afraid. But they intend having all they can get until forcibly restrained.

Further Municipal Gas-Works Results.

Reports with regard to the working of gas undertakings in the hands of local authorities still flow in; and their character is generally as satisfactory as that of the ones that have already been noticed. There is recorded at Blackburn an increase of some 7 million cubic feet in the total quantity of gas accounted for, while a greater amount of gas was made per ton of coal carbonized. Then comes Burnley, where there was an increased make of gas of 3·81 per cent. Of the meters in use 53 per cent. are on the prepayment system. From Cockermouth there is a small deficit; but this is mainly accounted for by a reduction in the price of gas, which will doubtless bring its reward in course of time. There was an increased sale of gas at Devonport of 4½ per cent.; and here, again, the consumers have enjoyed a reduction in price. The gas sales at Droitwich were 9½ per cent. larger than in the preceding year. The quantity accounted for per ton of coal carbonized is a record for the undertaking. Hebden Bridge reports a record make of gas; and at Hereford the gross profit is practically the same as before, in spite of a reduction in price running over the whole period, as compared with only six months the preceding year. The corner has been definitely turned at Morecambe, where the deficits experienced in the early days of Corporation control have lately been replaced by satisfactory profits. Neath and Oldham issue very satisfactory reports; and the latter transfers £7500 to the borough fund account. A substantial increase in the quantity of gas sold was experienced at Ossett, where for three-quarters of the past financial year the consumers have enjoyed a reduction in price. More gas was made at Padiham. At Ramsgate also the quantity of gas made was nearly 2¼ per cent. greater than in the preceding year; and in spite of a reduction in the price of gas used for power purposes, the revenue from gas sold exhibits a very good increase. A sum of £1000 is to be handed over to the district fund in aid of the rates. Stourbridge reports an increase in the quantity of gas sold, and a goodly surplus on the year's working. A larger amount of gas than in the preceding year was sent out at Stafford; and a feature of the accounts here is the unaccounted-for gas. This has now been reduced to the trifling quantity of 1·59 per cent., which is stated to be the lowest figure of any gas undertaking in the kingdom. The available balance is a record for the undertaking; and out of it £3500 is to be handed over in relief of the rates. The workmen receive their customary bonus, and the consumers are to have a reduction in price.

Slough Arbitration Award.

There is evidenced a feeling of satisfaction among the members of the Slough Urban District Council at the award that has been made by the Umpire in connection with the arbitration held earlier this year to determine the price to be paid for the undertaking of the Slough Water-Works Company. The proceedings were of a protracted character, extending over six days, and arose out of an Act of Parliament passed last year to carry into effect an agreement come to between the parties. The case for the Company was set out by Mr. Balfour Browne, K.C., who made a total claim of £111,477. The principal item was the maximum dividend payable to the shareholders and the interest on the debentures, which multiplied by 30 years' purchase came to £90,558; and to this was added 10 per cent. for compulsory purchase. As to the debentures, over which there was much discussion in the course of the hearing, one of the sections of the Act states: "In settling the amount to be awarded to the Company for such price or consideration, the arbitrators or umpire shall award as part of such price or consideration such a sum of money as they or he shall determine to be payable in satisfaction of the perpetual debenture stock of the Company outstanding at the date of the passing of this Act." Then there was a sum of £8706, the calculated present value of back-dividends, and £8691 for overspent capital. On behalf of the Council, Mr. Wedderburn, K.C., urged that there were various "elements of insecurity" about the undertaking—namely, the quality and quantity of the water and the high charges levied by the Company. In addition, it was argued that the mains were inadequate for public and fire purposes, and that larger ones and a new reservoir at a higher level were required. The basis of the valuation for the Council, as presented in evidence by one of the witnesses, was 22½ years' purchase of the maximum dividends, which, with the 10 per cent., made £68,523. To this was added £5000 (the face value of the deben-

ture stock), overspent capital (with adjustment), and the back-dividends (with further adjustments), giving a total of £80,941. The Chairman of the Council, however, in answer to a question when the award was made known to the members, said the figure suggested by the Council was about £84,000, *plus* the £5000 of debentures—making a total of £89,000. The award states the purchase price at £90,623, which is remarkably close to the figure mentioned by the Chairman as suggested by the Council; and it is very much nearer the valuation put forward by the witness referred to, than it is to the claim submitted on behalf of the Company. In addition to the award, the Council have to pay the cost of the parliamentary proceedings and the arbitration.

"New" Toddington, or Old Toddington?

It is a great pity the holders of a number of preference and ordinary shares in the New Toddington Gas Company, Limited (which shares are said to have been issued some years ago in respect of the purchase of, and improvements to, the Company's works) are forced to dispose of them, as it would be a charitable thing not to launch them on to the public. It is said however, that "the estate of the holders is now being realized; and the shares are therefore being disposed of." It is equally a pity that the holders chose to issue them through the Industrial Securities Investment Agency (Gas and Water Investment Department), of No. 6, Abchurch Yard, E.C.—an address associated with certain other enterprise that has not commended itself to our judgment. In the essential part of the prospectus announcing the sale, not a single personal name occurs; only the title appears of the useful piece of promoting machinery—the Agency mentioned. The value that the present holders of the 200 6 per cent. preference and 200 ordinary shares of £5 each place upon them is disclosed by the fact that they ask £4 each for them (that is, £1 below their nominal value), while interest is guaranteed at the rate of 6 and 7 per cent. respectively for three years, and to-day the shares will be entitled to six months' interest, which may be deducted from the final instalment payment—£1 per share; £3 per share having to accompany (as a "deposit") the application for any of the shares. Purchasers may be strongly advised to deduct the interest before confiding their cheques to the Agency; and, prior to parting with the cheques, perhaps it would be a sensible proceeding to see who are the persons constituting the Agency, and to what extent they have been associated with undertakings that have not been profitable investments for the public. We see, on the back of the present invitation to purchase shares, that there is a report of the "Opening of a Gas Cooking Exhibition at Toddington." The exhibition it appears was "opened" by Dr. W. R. White, Chairman of the Directors, who is also described as Chairman of the Directors of "several successful gas and water companies." We should like to have the names of these "successful companies." A case was before Mr. Justice Warrington in April last year, in connection with certain Eaton promoting operations; and his Lordship, in that instance, said Eaton and White had been guilty of misfeasance and breach of trust, and he ordered (in respect of the Company concerned) an inquiry into the profits made by these two men. The ingenuity of a certain class of promoters is extremely interesting; but we regret to see a recurrence of raids on the public through the gas industry.

"Natural Gas."

The "Financial News" also learns that once more the shares and bonds of the South of England Natural Gas and Petroleum Company, Limited, are being "pushed" through the post, this time by circulars from the Sussex Coal and Petroleum Concessions Syndicate (not Limited). The contents of the circulars issued in connection with the South of England Natural Gas and Petroleum Company are described as "bunkum of the most unqualified character." As far back as February of 1910, these "securities" were being hawked about. Our contemporary notices that the name of the London Joint-Stock Bank is used in the application form set out with the latest touting circular.

Depreciation and Income-Tax Allowance.

With reference to the circular-letter which has been issued by Mr. W. A. Schultz, of No. 50, Cannon Street, E.C., to gas companies, we understand that a further communication from the Committee will shortly be sent to every gas company; and it will be published in the "JOURNAL."

PERSONAL.

Alderman JOHN BICKERSTAFFE, J.P., of Blackpool, has been re-elected Chairman of the Fylde Water Board.

Mr. T. J. NODEN, of Longton, has been appointed Manager of the Whitchurch (Salop) Gas-Works. Mr. Noden served his indentures as a pupil with Mr. W. Langford, of Longton, and was appointed Assistant-Manager of the Longton Gas-Works, in January, 1909. He will commence his duties at Whitchurch on the 1st prox.

A change in the engineering staff of the European Gas Company will take place in a few weeks, when M. AUGUSTE PESCHOT, the Manager of the Bolbec station of the Company, will retire, on a pension, after forty-one years' service. M. Peschot is one of the oldest members of the Société Technique, having been admitted in 1879.

Mr. T. P. FRANK, City Engineer and Sanitary Inspector to the Ripon Corporation, has been appointed, out of 180 applicants, Borough Surveyor and Water-Works Engineer at Newark-on-Trent. Mr. Frank served his articles in the office of the Borough Engineer and Surveyor at Huddersfield; and before going to Ripon, he was Deputy Borough Surveyor and Water Engineer at Dewsbury.

At last Tuesday's meeting of the London County Council, the resignation of Sir MAURICE FITZMAURICE, C.M.G., of the office of Chief Engineer of the Council was announced, to take effect from the end of the present year. The resignation was accepted with regret, and testimony was paid by the Chairman (Lord Cheylesmore) and other members of the Council, to the services of Sir Maurice. Since 1902, Sir Maurice Fitzmaurice has held the position of Chief Engineer, and during this period he has carried out not only the engineering work connected with main drainage, bridges, roads, &c., but has constructed the Rotherhithe and Greenwich tunnels, and the embankment for the new County Hall, besides many tramway works and the construction of a large intercepting sewer. He received his knighthood on the occasion of the laying of the foundation stone of the new County Hall.

It will be seen, from an announcement appearing elsewhere, that the Directors of the South Suburban Gas Company are inviting applications for the position of Secretary, which has now become vacant by the retirement, through considerations of health, of Mr. CHARLES M. OHREN. The present Secretary is fifty-nine years of age; and forty-four years have been passed in the service of the Company. It will probably be remembered that the secretaryship was for 38 years held by Mr. Magnus Ohren, on whose retirement in October, 1893, his son, who had been his assistant, was appointed to succeed him. He will, we understand, receive the maximum retiring allowance to which his years of service entitle him. All his friends—and they are numerous—will, we are sure, unite with us in wishing him long enjoyment of the rest that he will now obtain by relief from his responsible duties.

OBITUARY.

Mr. W. H. ROTHWELL, who died at Fairhaven, near Blackpool, on the 18th inst., aged 76 years, was formerly Secretary to the Ashton, Stalybridge, Dukinfield, and District Joint Water Board—a position he held from its formation in 1878 down to about four years ago, when he retired, and was made "consultant adviser."

The death occurred last Saturday, at the age of fifty-three, of Alderman JAMES G. FROST, J.P., of Boughton Hall, Chester, the Chairman of the Chester Gas Company and of the Hawarden Water Company, and a Director of the Chester Water Company. Deceased had been a member of the Corporation since May, 1896, and was Mayor of the city in 1902.

It is with regret that we record the death recently of Mr. GEORGE BIRD, A.M.Inst.M.E., and a Life Member of the London Association of Foremen Engineers and Draughtsmen. The deceased gentleman had a large circle of friends; being intimately connected with most of the gas companies in London, both financially and through the medium of trade. For some two or three months he had not enjoyed good health, and on medical advice went to Buxton to undergo special treatment. Unhappily, while there he contracted pneumonia, and died suddenly. A number of business friends attended the funeral, which took place at Earley, near Reading, where his country seat was situated. Mr. Bird was connected with the firm of Messrs. James Bartle and Co., Engineers, of the Western Iron-Works, Lancaster Road, W.

Eighth International Congress of Applied Chemistry.—The last press bulletin has now been issued in connection with this Congress, which will open in Washington on Sept. 4. It gives the titles of 148 additional papers out of a grand total of 683 papers now definitely promised to be read before the twenty-four sections. At the meeting in 1903, the total number of papers presented was 479; in 1906, 658; and in 1909, 985 papers, as against 683 promised to date for the forthcoming meeting.

NOTES FROM WESTMINSTER.

THE South Suburban Gas Company's Bill is in a group of measures now before a Committee of the House of Commons. The Bromley Corporation were opposing; but they have resolved not to appear before the Committee. We take it, however, that the Committee will hear something of the Bill—at any rate, in connection with the petition of the London County Council (supported by the Lewisham Borough Council), in which they ask that, in order to contribute to uniform testing, the standard of quality of gas bearing penality for lapses should be changed from illuminating power to calorific power, as in the Wandsworth, Wimbledon, and Epsom Gas Bill. The Chairman (Mr. Charles Hunt) and Directors of the South Suburban Company have no objection to the change on terms that they deem consistent with the penalty-point of their standard quality of illuminating power—the penalty-point (13½ candles) being ½ candle lower than the standard to which they work. We have little doubt that it will be found that the County Council and the Board of the Company have arrived at an amicable agreement.

South Suburban and Calorific Power.

Wandsworth Amalgamation Bill. The Wandsworth, Wimbledon, and Epsom Gas Bill is now free to proceed; and thus the two large gas amalgamation schemes of the session—the South Suburban one being the other—are assured of consummation. The Surrey County Council and the Epsom Rural District Council had threatened further opposition to the Wandsworth Bill not on the amalgamation question, but in regard to getting further power in the matter of the distribution system; but they have withdrawn.

Chemical Clause. Since the last budget of "Notes" was published, the Local Government Board have been instrumental in inserting words in Gas Orders that have been under their scrutiny and revision, which words restrict the operations of the promoters in the matter of residual products in the same manner as the chemical clause. The movement is dealt with in our editorial columns. The Alkali Manufacturers' Association are opposing the Gas Section of the Birmingham Corporation Bill in the House of Lords. We hope the Corporation will fight this piece of injustice, and thoroughly expose it.

Benefit Funds Bill. The Brighton Corporation, after their undignified appearance and beating in the House of Lords in the matter of the Benefits Funds Bill of the Brighton and other Gas Companies, determined, on second thoughts, not to court a second rebuke by showing hostility to a measure that is to benefit a large number of working-class families in the borough. Their previous antagonism brought to them a good measure of local censure. The Bill has been before the Unopposed Bills Committee of the House of Commons; and now goes forward to the final formal stages.

Wiring and Hiring at Sheffield. Sir Henry Kimber's Committee of the House of Commons have determined that, under the exceptional circumstances of the case, the Sheffield Corporation may have the powers to continue their hiring and wiring business in connection with the Electricity Department. The position, of course, is exceptional; but the local contractors and the Chamber of Commerce are dead-against the Corporation proceeding with this business. The circumstances are these: When the Corporation some fourteen years ago took over the electricity supply business from the Company running it, a wiring and fittings business was attached, for which they specifically paid a considerable amount. But the local contractors and the Chamber of Commerce have always held that the Corporation had no legal power to conduct this business in opposition to the local traders; and there has been constant friction between them over the matter—resulting eventually in litigation. The upshot of it was that Mr. Justice Swinfen Eady recently gave a decision against the Corporation, as Mr. Justice Neville did in the Leicester case. The matter is now on the road to the Court of Appeal; but if this Bill succeeds further litigation will be unnecessary. Mr. Justice Swinfen Eady's decision means that he is of opinion that the Corporation have not the power to carry on the business; he had not to decide as to the propriety of their doing so. The latter is the question that is to be settled by the Bill before Parliament, in which the Corporation seek to regularize what they have been doing. As the result of the first brush, they have won. But the decision of the Committee does not endorse the policy of municipal trading; it merely says that, under the special circumstances of Sheffield—having purchased this business as part of the electricity undertaking, and the Corporation having carried it on for fourteen years—they should be allowed to continue it. Whether this view will be sustained throughout the parliamentary piece is not certain.

Electrolysis in Carlsruhe.—Electrolysis of gas and water pipes in the city of Carlsruhe, due to stray currents from the rails of electric railways, has been investigated by Herren Geppert and Liese, and the results of their studies have been published. They point out that destruction of the pipes will result where the current passes out of the pipe into the surrounding earth. At points where the current enters the pipe from the earth, however, a protective rather than a destructive action results; and the relief measures adopted at Carlsruhe are based on this principle.

ELECTRICITY SUPPLY MEMORANDA.

An Illogical Teacher—Cooker Unreliability and Higher Initial Costs—How to Enable Electric Cooker Makers to Recover from Decline—Expert Replacing of Fuses—Halfpenny per Unit—The M. E. A. on Electric Cooking—The Ill-Fated Bill—Higher Rates for Electric Apparatus.

THE "Electrical Times" has set itself the task of putting us right over the subject of the loss of weight of meat in gas and electric ovens. It has done so in a most illogical article, in which imagination takes chief part. As a matter of fact, if the leading argument of our contemporary as to a violent rush of air through the gas-oven were true, this popular adjunct of the kitchen would not get hot at all, and the joint would remain unaffected, instead of being done, as is electrically misrepresented, to a cinder. If a later argument in the same article be the correct one, the oven should be constantly violently hot, and incapable of regulation. The article turns experience topsy-turvy, and tells us that we have been the victims of gross deception—that things are not as we find them, but are actually altogether different. Our electrical friends are suffering from the peculiar notion that they will make converts of people by maligning their intelligence. This is a stupid mistake. However, the article is discussed elsewhere in this issue. As the matter had its origin in the "Memoranda," it is sufficient to mention here that our contemporary's intentions—excellent or otherwise—have not been overlooked, and have received the consideration that they merit.

We pass from the illogical argument on temperatures, and from the mysterious disappearance of moisture—valued by the electricians at 10d. and 1s. per lb.—from joints baked in a barbarous fashion in a gas-oven, to the question which Mr. A. H. Seabrook recently raised in the same contemporary. It will be remembered that Mr. Seabrook finds that reliability is one of the chief things that householders want in their cooking arrangements. People who can afford the price, and who keep the staff necessary to look after electric cooking appliances, think more of reliability and punctuality of meals than they do of anything else. The other arguments of the advocates of gas and electric cooking do not appeal to them at all. Mr. Seabrook has, it may be taken, had a bad experience; and he wants every part of the organism of an electric cooking range sequestrated, and supplied each with a fuse, at an additional cost of 20s. to 30s. per oven; so that, if one part fails, it may not place the whole outfit *hors de combat*. In the succeeding number of the "Electrical Times," Mr. Seabrook had two strong supporters, and one weak opponent—the latter of whom effectually sheltered himself behind the *nom de plume* of "Didvanos." The other two writers agree with Mr. Seabrook that, if electric cooking is going to reap any measure of success, a good job must be made first of the apparatus and then of the installation. Their letters show that good construction and installation must be had regardless of expense. The letters are worth glancing at, as they illustrate that experience is proving the necessity of giving a wide berth to the cheap and nasty variety of electric cooking appliances.

The first letter is by Mr. C. George Nobbs, of Purcell and Nobbs. Mr. Nobbs takes us seriously into his confidence. As a heating, ventilating, and electrical engineer, he brings competent judgment to bear on the question. Hearken to this from Mr. Nobbs: "No matter how substantial or reliable the apparatus, there is a time when sections of the heating equipment will give out from oxidation, overheating, &c." Just so. People who electrically cook anything more than one joint a week and a few odds-and-ends, are having excellent experience of the susceptibility of the vital parts of electric cooking apparatus to derangement. Mr. Nobbs proceeds to say that the heating equipment of electric cooking apparatus of all kinds should be subdivided into as many sections as practicable—certainly not greater than 8 to 10 ampere circuits, with separate fuses—and thus localize failure to the respective device, and obviate entire breakdown and dissatisfaction. Further to the making of a good job of the installation, he advocates that fuses and heat-regulating switches should be mounted on a separate board fixed adjacent to the domestic cooking range, with luminous screens or other form of device to indicate where current is "on." For the larger pieces of commercial or restaurant type apparatus, his view is that the switches should be fixed locally on the apparatus, thermally insulated and protected from mechanical damage, liquids, moisture, &c.; fuses being preferably mounted on one or two ironclad water-tight distribution-boards fixed on, or adjacent to, the apparatus. This is pushing up installation expense with a broad-minded generosity. Another question is why are some electrical people running after the very thing that will do an incalculable injury to their cooking business—if they have any. Mr. Nobbs says the "real reason" for this is that people are clamouring for electric apparatus as cheap as gas lines; but the "vital reasons" are that those who produce cooking apparatus have not the necessary experience in the design and construction of practical goods. That is very cutting. Mr. Nobbs is also of opinion that it is impossible to get down to gas prices for electric cooking appliances, owing to the fact that a "gas-cooker is literally poured out, whereas an electric cooker is both poured and, in parts, built of rare metals." The gas-stove makers will be interested in learning that their work is child's play compared with that of the electric cooker maker. However, good prices must (with an emphasis on the "must") be

paid so as to allow electric-cooking apparatus makers "a better chance to recover from the *decline* into which they are being driven." Has it already come to this? We know the character of unreliability is having swift circulation from the comparatively few people who have so far been tempted by, and have yielded to, the eloquent, though vacuous, representations of the electrical charmer.

The next supporter of Mr. Seabrook is Mr. J. P. Annacker; and he thinks our Marylebone friend has not gone far enough. This gentleman is anxious to place it out of the power of a user of electric cooker appliances to replace a blown fuse; so that a recognized contractor, or the officials of the electricity supply authorities, must be called in. Why only one contractor should be called in, while the "officials" of the supply authority would be requisite, is not plain. What is plain is that it is the deliberate view of Mr. Annacker that expert qualifications are needed to look after the most modest difficulty arising in connection with the disablement of electric cooking appliances. This correspondent does not like the idea of the user expending his amateur energies on experiments which would probably leave the condition of the apparatus worse than it was at the moment of the failure. This shows the sensitiveness of electric-cooking apparatus, and the slight division there is between good and bad behaviour, or between the user and disaster. The other letter, the one from "Didvanos," points to what is a fact that all places cannot boast of plutocratic residents as Marylebone can; and in those other places, the extra cost of 20s. to 30s. required to render cooking appliances more reliable would be a great thing. He is not conscious of this fuse question having any great bearing; but perhaps he has not had the electric cooking experience that some other folks can claim.

Certain electricians have a curious way of showing their belief that cooking by electricity is an economical proposition, and that those who employ this method of preparing food will be much in pocket by adopting it. Computing at 10d. or 1s. per lb. the differences in water-savings that the electricity people assert there are as between joints cooked in electric-ovens and in gas-ovens, they ought to be able to sell the energy for cooking at lighting rates, and do a tremendous business in this direction. But what are the facts? Endeavour is being made to develop the cooking business in most places at 1d. per unit—not at lighting rates—but with little or no effect. Some electrical engineers are not at all bashful in acknowledging their inability to make things go at 1d., and a few of them have come down to ½d. This is the best testimonial they could possibly give to the heating inefficiency of electricity, and to the absurdity of the extravagant claims made by the electric-cooker enthusiasts. The Reading Electric Supply Company are among the latest to proclaim the inefficiency of electricity for heating and cooking by coming down to ½d. per unit—one-tenth (we believe) of the price they are charging for lighting purposes. To learn how they would attempt to justify the figure would be interesting. Heating is a matter for the winter months mainly, when the hours of daylight are few, and the hours of darkness many.

With overlapping, where is the reasonableness of charging 5d. for lighting, and ½d. for heating and cooking? Again the people who can afford electric cooking appliances (with their heavy initial, installation, and maintenance outlay) are those who are likely to have their dinners cooked in the evening—again for a considerable part of the year during lighting hours. But perhaps the Company are aware that they are not likely to do very much business at even ½d. per unit; and the flutter from the advertising point of view may be worth the loss that will be incurred. The level ½d., however, is only to apply to householders who take current for lighting purposes; and so double wiring and metering are involved. Anyone, however, can have current for cooking and heating at ½d. by consuming more than 20 units in a quarter, which 20 units will first be charged at the statutory rate of 13s. 4d. No charge is to be made for the use of meters; so that the shareholders of the Company will—taking all things into account—be doing a grievous wrong to their own intelligences if they anticipate a flight upwards of their dividends as a result of this new move. Barnes is also to have electricity for the same purpose at ½d. per unit. Southampton and Luton are predecessors in this ½d. per unit business for heating and cooking; but no news of big things being done by the undertakings is forthcoming. Halfpenny rates, under certain conditions and lump charges, may be found at Poplar and Marylebone; a few others may be discovered who have a lump charge and the ½d. per unit in force.

There was much talk at last week's meeting of the Municipal Electrical Association on the subject of electric cooking; and there were also produced some singular looking curves which are supposed to show something more than the incipient stages of the business that, in the night dreams of electricians, assumes gigantic proportions. There is nothing sensational or particularly striking about the papers or the discussions, so that they can wait a week for a few comments.

Here we are nearly at the end of June, and that unfortunate measure of the Municipal Electrical Association is still hanging about the House, and nobody appears to be taking compassion on it. The latest information about the Bill in the records of the House runs as follows: "Electric Lighting [198]. Brought in by Sir Howell Davies. Second Reading [*Dropped.*]" The word "Dropped" refers to the second reading; but until it has had a second reading, it is in a state of suspended animation. The chances of the measure going through this session have become very shadowy. Up to the present time, we have not seen any announcement as to the result of the further appeal for funds to help forward the measure, which impudently suggests to the Legislature that the municipal part of the electricity industry should be invested with powers that are altogether opposed to parliamentary precedent and principle. The Board of Trade is not likely to adopt the measure as it stands; and the Local Government Board will most certainly have a voice regarding the proposed trespass upon its prerogatives in connection with municipal finance.

In an article by Mr. H. H. Holmes, the Sales Manager of the Marylebone Electricity Department, a good many business principles are thrust forward with the intention that they shall get home. It is a truism which no one can gainsay that "the business which succeeds—other things being equal—is the business which responds most readily, most willingly, and most completely to the desires of the customer, and the business which best serves the customer best serves itself." Mr. Holmes is out urging the adoption of the hire system for electric apparatus. He points out all the difficulties that face the householder in introducing electrical appliances into the *ménage*. The householder is faced by the knowledge of the rapid improvement in apparatus (though the grumbling there is over the unreliability of electrical apparatus discounts, in the eyes of the onlooker, the present-day position of the apparatus); by the experience with kettles and irons, which causes him to hesitate in flying to the fresh evils that will be introduced by apparatus of a larger order; by the fact that, if he purchases such apparatus outright, there will be "a constantly recurring expense of an indeterminate nature;" and by an expenditure of somewhat alarming proportions in transferring the apparatus if he wishes to change his domicile. There are other points. But throughout the article, we have the inklings from a man who knows of the enormous irregularities there are in the service of electrical apparatus. We saw recently that in Marylebone the user of electrical apparatus has the even tenor of his or her way disturbed every few days by the visit of a competent expert; and Mr. Holmes insists on this as the less of two evils—collapse of apparatus and dissatisfaction of consumer, or else the annoyance occasioned by frequent visitations. He remarks that the regular visits and reports of the maintenance men at once call attention to incipient trouble and dissatisfaction before either "go" [*sic*] too far; and, what is more, the revenue obtained from hire is generally sufficient to enable one to employ a really good "trouble" man—excellent term!—to attend to the worst, and what might otherwise be hopeless, cases.

But all this pales in the face of the greatest consideration of all for the patient householder. "The gas companies" remarks Mr. Holmes, "are prepared—nay, willing and eager—to supply him with gas apparatus; and he [the householder] cannot but think it unreasonable that his electricity suppliers should not offer him similar facilities. He would not lay so much stress on this point if the electrical apparatus were cheap to buy (cheaper than gas apparatus for a similar duty), but the reverse is the fact, and in many cases *very much the reverse*." This mirrors an important argument against local electricity supply authorities being allowed hiring powers, save on very firm conditions. With such high initial costs, such heavy maintenance charges, such costs for nursing, then—if the energy is supplied at figures a considerable depth below the lighting rates—the hire rates ought to be of a character that will cover all the outgoings in connection with the apparatus. The reason gas suppliers are able to offer such low hire terms is that the gas is, as a rule, for the cookers and heaters supplied at the lighting rates—only in a few cases is a discount allowed, and then the discount has not the absurd ratio that exists as between the charges for lighting and other purposes in the case of electricity.

April 9 Issue of the "Journal" Wanted.

The unfortunate foundering of the "Titanic" resulted in all the copies of the "JOURNAL" dated April 9 addressed to American subscribers being lost; and it has been impossible to replace the whole of these from the surplus stock in hand of this number. If, therefore, "JOURNAL" readers have by them any numbers for this particular week, and are willing to dispose of them so as to allow our American subscribers to complete their volumes for the current quarter, it would be a great convenience if they would forward the numbers to the office here. The amount for any numbers supplied shall be credited to accounts, or stamps sent for the repurchase of the issue referred to. We shall be glad to purchase these numbers to the extent of 200 to 250 copies at the very least.

Humphreys and Glasgow, Limited.—A Joint-Stock Company has been registered, with a capital of £100,000, in £1 shares, to acquire the business carried on at, or operated from, Victoria Street, Westminster, of Messrs. Humphreys and Glasgow. The signatories are: Messrs. A. G. Glasgow, M.Inst.C.E., T. Thuman, and J. C. Stelfox. The Directors (not less than two nor more than ten) are Messrs. A. G. Glasgow (Chairman), T. Thuman, and J. C. Stelfox. The registered Office is at Nos. 36 and 38, Victoria Street, Westminster, S.W.

SOCIÉTÉ TECHNIQUE DE L'INDUSTRIE DU GAZ EN FRANCE.

THE THIRTY-NINTH ANNUAL CONGRESS—Paris, June 18 to 20, 1912.

REVIEW OF THE PROCEEDINGS

[From Our Own Correspondent.]

The Thirty-Ninth Annual Congress of the Société Technique de l'Industrie du Gaz en France was opened last Tuesday in the hall of the Society of Civil Engineers of France, Rue Blanche, Paris, by M. Henri Marquisan, one of the Directors of the Marseilles Gas and Electricity Company, who with this meeting completed his two years' occupancy of the presidential chair. There was a fairly good attendance of members; among those from London being Mr. W. B. Brady, General Secretary of the European Gas Company, and Mr. E. C. Bode, of the Continental Union Gas Company.

General Meeting.

The first business was the presentation of the report of last year's proceedings at Marseilles, as contained in the volume of "Transactions;" and it was unanimously adopted. Then came the admission of new members. It is customary with the Société Technique to elect the President of the Institution of Gas Engineers an honorary member. But Mr. Corbet Woodall's name is already in the list; and therefore it was not necessary to re-elect him. The meeting proceeded to ballot for members of the Committee, of whom seven were retiring. All were re-elected.

The next item on the programme was the presentation of the

Report of the Committee.

This report opened, as customary, with some references to the life-work of members who had been removed by death; four of them being in the honorary, eleven in the ordinary, and four in the associate list. The honorary members were our compatriots —Messrs. W. J. Warner and James Stelfox, in 1908 and 1910 respectively, and Messrs. S. W. Durkin and Robert Morton last year. The Committee remarked that the high position held by these gentlemen in the gas industry justified their selection for the presidency of the English Gas Institution; and they said they were sure they were interpreting the feelings of their colleagues in "saluting with their sympathy and regret the memory of engineers whom they felt it an honour to include in their number as the authorized representatives of the English gas industry." Particulars followed of the other deceased members; and then the names of those who had left the Society were given. These changes and the new members admitted made the roll as follows: Honorary members, 20; ordinary members, 671; associates, 150 —total, 841.

Next came the list of the contributions made by gas companies to the funds of the Society, ranging from 3500 frs. in the case of the Paris Gas Company down to donations of 50 frs., and totalling to 31,760 frs. (£1270), compared with 28,710 frs. (£1148) for the year 1910—an increase of 3050 frs. (£122). The Committee regard this as a striking testimony of the interest taken in the Society and its work; and they expressed their sincere thanks to the donors of the amounts constituting the above-mentioned total, especially those who had generously increased their contributions. These additional resources would, they said, enable them to maintain at the number of forty the prizes to be awarded to meritorious foremen and workmen, but also, if possible, to realize a wish expressed by several of their colleagues to effect an improvement in the method hitherto followed of bestowing these awards, by setting up certain distinctions between the recipients, without confining themselves to only one type of award. A Committee has been appointed to consider this matter; and the result of their deliberations will be announced at next year's meeting. With these additional funds the Committee will be able to place at the disposal of the Technical Commissions the means of extending the programme of their labours, to facilitate the establishment of competitions in connection with work bearing upon professional training, and to reward the efforts of those—and their numbers are increasing—who are following up the question of the application of gas in the industries, such as the heating of bakers' ovens, and for small apartments, &c.

Dealing further with the improved financial position of the Society, the Committee stated that it would enable them to consider the possibility of holding a meeting in the autumn, in Paris, of the International Commission on the Standardization of Screw-Threads. Particulars of the work already done by this Commission appear in the "Transactions" for 1910; and they have also been noticed in the "Journal." A Special Committee has been formed to make a comparative study of the proposals of the foreign delegates and those submitted by the Society's own representatives. The Committee expressed the hope that in the course of the next session a further step will be taken in the direction of arriving at a much-desired understanding on the various matters under consideration.

The Committee next gave a summary of the results of the proceedings of the International Photometric Commission held in Zurich last July, full particulars of which have appeared in the "Journal." The Commission expressed a very strong opinion in favour of the calorific test for gas; and the Committee cordially support it. Its adoption in France would, they consider, get rid of a serious cause of difficulties arising in connection with the terms of the concessions under which Continental gas companies work, and at the same time remove needless, and what appear to be purely vexatious, requirements. The Committee have conveyed to the Commission their concurrence in the view set forth.

There is a new feature in connection with this year's meeting of the Society, in the shape of an award of prizes by the Central Coke Committee of France. This is a competition instituted with the view of effecting improvements in the appliances for utilizing gas coke for heating purposes; and the Society confided to the Central Committee the task of examining all the appliances submitted. M. Rouland, the Managing-Director of the Paris Gas Company, is the President of the Committee; and he intimated that the prizes would be 5000 frs., 3000 frs., and two of 1000 frs. There were three competitors; and the results of the testing of their respective appliances were furnished in a special report presented at the afternoon sitting. The Committee warmly congratulated the Central Committee and its President on the encouraging results of the first competition, and thanked them for taking the initiative in a matter which has already produced good results.

The Committee expressed their pleasure in recording the perfect union existing between the Society and the Professional Syndicate of the Gas Industry—a body occupying itself with proposals emanating from the Government which are calculated to affect the gas industry. M. Piaton, who held the presidency of the Syndicate for the past three years, has lately relinquished it. Opportunity is being taken to rearrange the Society's library, a catalogue of which is being prepared by the Permanent Secretary (M. Henry Bouron), to whose ability and devotion to his duties the Committee bore hearty testimony.

The concluding lines of the report were devoted to an interesting proposal emanating from M. Delahaye; and it has been accepted by the Committee by acclamation. Among the members of the Committee there are two of the founders of the Society—M. Albert Ellissen and M. Joseph Ancel. The former was elected to serve on the Committee in 1874, and was President in 1881 and 1888; and latter was on the Committee in 1879, and President in 1883. M. Delahaye's suggestion was that, seeing that the Society have power to reward long and meritorious service on the part of foremen and workmen, they might do likewise in the case of administrators who had continuously for so many years set before the members the example of the highest professional qualities, which had contributed largely to the progress of the gas industry. The Committee thought there could be no better recognition of the services of the gentleman named than the presentation to them of the bronze medal awarded to workmen; and this, they said, would be done at the banquet of the Society the next evening, when they hoped there would be a numerous gathering to testify their esteem, affection, and profound respect for their two Past Presidents.

The report was unanimously adopted.

Report of the Treasurer.

The report of the Treasurer (M. Frère) was also presented. It showed that the revenue last year was 73,505 frs. (£2940), and the expenditure 90,396 frs. (£3616). The latter included 9915 frs. for prizes, and 1573 frs. for investigations and for the library. At the close of the year, the Society's capital amounted to 214,716 frs. (£8589), compared with 213,269 frs. (£8531), or an increase of 1447 frs. (£58).

The report was approved.

Opening of the Congress.

At the afternoon sitting the Congress was formally opened. The President announced that the "bureau" for the ensuing year would be as follows: President, M. Boutan; Vice-Presidents, MM. Delébecque, Rouland, and Kaeuffer; Secretaries, MM. Gaston Gautier and Rolland d'Estape; and Treasurer, M. Frère. It may not be without interest to mention that M. Gaston Gautier, who is the Engineer of the Havre station of the European Gas Company, has been accredited to represent the Company before the Minister of Finance.

Medals and Awards to Employees.

The President then introduced M. Tirman (present on behalf of the Minister of Commerce and Industry), who took the chair and opened the Congress—expressing his pleasure in attending, as representative of the Government, to distribute the medals for meritorious service awarded by them. He laid stress upon the value of the work done by the Society, and emphasized the importance of educating the workmen. He then proceeded to distribute the medals.

Next came the distribution of the Society's medals and pre-

miums. There were 17 silver medals to employees, 20 premiums of 200 frs. to foremen, and 163 of like amount to workmen. This year the Committee have awarded 20 supplementary prizes solely for candidates who have had at least 35 years' service; and they trust this will be an additional proof of the interest they take in the *personnel* of gas-works. They thanked the various companies concerned for their financial assistance, as without this the ordinary resources of the Society would not allow of their making any additions to these awards, as they have long desired to do.

At this point M. Tirman left the meeting, and the President took the chair.

Prizes for Papers.

Four of the papers read at last year's meeting were by members of the Committee, and consequently their authors were ineligible for prizes. They were the communications of MM. Delahaye, Cornuault, Laurain, and Rolland d'Estape respectively. M. Delahaye gave the results of five years' experience with carburetted water gas; M. Cornuault dealt with the supply of coke-oven gas, and increasing the sale of gas, taking Copenhagen and Zurich as examples; M. Laurain explained the principles of condensation as conducted in the Paris Gas-Works; and M. Rolland d'Estape described the "Marseillais" water-heater. M. Defoy presented two papers—one on a recuperator furnace which could be easily cleaned, and the other on the variations in the volume of gas liberated in the course of carbonization; and the Committee awarded him a prize of 300 frs. M. de la Boulaye gave a full account of the experiments at Angers on automatic gas lighting and extinguishing appliances; and he has received 200 frs. M. Grebel dealt with direct sulphatation and the removal of tar from gas, and also presented some comparisons between upright and inverted incandescent gas-burners at low pressure, as opposed to compression. He has been awarded a prize of 200 frs.

As already mentioned, the Committee of the Society received a report from the Central Committee on Coke, and it was read at the afternoon sitting. The appliances presented related respectively to domestic and industrial heating. M. Arthur Martin (a member of a firm well known on the Continent) sent a heating-stove to which he had given the name of "The Cock;" and M. Poulain, of Paris, a grate constructed entirely of sheet-iron. MM. Stein et Cie., of Paris, sent an assortment of coke stoves and furnaces for metallurgic work. The appliances of MM. Martin and Poulain were tested in the Laboratory of the Conservatoire des Arts et Métiers. M. Martin satisfied the conditions, and he has been awarded a prize of 2000 frs. In the case of M. Poulain, the Committee did not think his arrangement effected what he called "continuous double combustion;" and therefore they have not made any award. With regard to MM. Stein's appliances, the Committee expressed the opinion that the firm had the merit of having completely solved the problem of the employment of gas coke in the thermic treatment of steels, and had in other respects opened many new and important outlets for the gas industry. In acknowledgment of their efforts and of the results achieved, the Committee awarded them 5000 frs.

Reports of Commissions.

Next came the reading of the reports of the Technical Commissions of the Society on Instruction, Coal Testing, and Manufacture. Abstracts of them will be found in another part of the "JOURNAL"—pp. 977-82.

Papers and Discussions.

A commencement was then made with the technical business.

The first paper taken was that of M. Masse, the Engineer of the Société d'Éclairage, Chauffage, et Force Motrice—the Company supplying gas in the principal suburbs of Paris—who dealt with the question of the coal supply to gas-works, regarded in the light of the recent miners' strike in England. The views set forth by M. Masse will be found in the translation of his paper appearing on p. 983. He favours the importation of American coal, the storage of coal under water, and working from a mixed stock. M. Rolland d'Estape pointed out that the storage of coal under water was attended with inconvenience. He stated that in his works at Marseilles the coal is stored in pits constructed of cement concrete; the consequence being that when heavy rains occur the coal at the bottom is steeped in water. In using this coal a number of troubles arose. First of all, the action of the charging and discharging machines was interfered with; and next it would be necessary to have 10 per cent. more retorts for the same production of gas, if the system suggested were adopted. Moreover, higher heats would be required in order to evaporate the water from the wet coal, and 20 per cent. more coke would be wanted for the furnaces. This would mean additional labour, &c. M. Masse's answer to these objections was that it would not be advisable to make use constantly of the coal which had been submerged. It should be resorted to only occasionally; and then it would but rarely interfere with regular working.

M. Masse had a second paper, in which details were given of the system of mechanical account-keeping in use by his Company. The subject was broached to M. Masse three years ago by M. Charnit, the Chief Outdoor Engineer; but his organization was not then considered satisfactory. Two years later, however, he submitted machines which answered all requirements, and they were adopted. A description of these and an account of their work was the subject of the paper. The author stated that with an equipment consisting of a type-writer, two receipt-machines, and two others for the debit notes, working eight hours per day and 25 days per month, he could deal with the accounts of 54,000 consumers. It was estimated by him that the use of the machines would allow of a reduction by about 25 per cent. in the clerical staff of a company. The machines are guaranteed for ten years; and it was reckoned that they would pay for themselves in two years. The paper was an account of a successful attempt to introduce into the office department of a thoroughly up-to-date gas company in respect of its productive plant, labour-saving appliances which modern business developments have placed at the disposal of those who are responsible for the delivery and collection of accounts. Though the undertakings managed by some of M. Masse's audience are too small to justify a great change in the office equipment, there may be others in a different position; and therefore the details given in the paper were worth attention. There were no remarks on the paper.

M. Masse was followed by M. Crozet, who described an arrangement for the mechanical operation of medium-sized gas-works. At the close, M. Delébecque remarked that the author had spoken of an important economy in labour. He questioned whether two stokers would be sufficient for seven settings. M. Crozet replied that this would be possible, were it not for the trade syndicates interested.

A long and important paper on the subject of "Comburimetry" was submitted by M. André Grebel. The author has lately been dealing with it in the "Journal de l' Eclairage au Gaz," and reference has been made to the matter in the "JOURNAL." M. Grebel has ingeniously coined a word to represent the measurement of the quantity of air or oxygen necessary for the complete theoretical combustion of the various combustibles—particularly those which are gaseous, by means of "comburimeters." We talk of photometry and photometers, calorimetry and calorimeters; then why should we not adopt M. Grebel's new word in regard to the measurement of the special property of gas in question? Having given a few definitions, the author dealt at length with the useful applications of comburimetry—viz., in connection with lighting by incandescence, heating, motive power, and testing town gas—and concluded by describing what he considers the right kind of instrument in connection with it. It is the production of MM. Velter, the makers of the Sainte-Claire Deville burner and the standard calorimeters of the City of Paris. This paper is worth noticing at greater length, in conjunction with the diagrams accompanying it. M. Grebel remarked at the close of his paper that if the determination of the "comburivous power"—*i.e.*, the air or oxygen absorbing capacity of a gas—will not take the place of the determination of the calorific power, it may at all events give an indication of the changes in the quality of the gas produced. In a foot-note to his paper, he quoted M. Sainte-Claire Deville to the effect than an apparatus measuring the quantity of air needed for combustion "may be utilized as a rapid and approximate indicator of the quality of a gas, without using either a photometer or a calorimeter," M. Grebel pointed out that as testing will be simple and instantaneous with a good comburimeter, he ventured to hope that gas men would interest themselves, from the outset, in the subject of his paper, which, he considers, "is destined to effect the realization of great progress in the utilization of the various industrial gases, and, in combination with calorimetry, to render very important service in the testing of town gas." The author summarized his communication, and added some explanations on the subject. By the aid of a diagram, in coloured chalks, placed upon the blackboard, he described how it is possible to represent gases in co-ordinates, in the function of their calorific and "comburivous" powers.*

M. Guillet cited, in support of the opinion expressed by M. Grebel, a recent study by M. Le Chatelier. The latter explained that with the present processes of distillation and modern carbonization chambers, gas is produced which is poorer in lighting power and in heavy hydrocarbons than that made formerly. The consumer, however, gets compensation for this, as the gas now supplied to him has a much higher temperature when burnt than that of the gas he previously used. Then followed a veritable passage-of-arms between M. Sainte-Claire Deville, M. Grebel, and M. Guillet. It appeared that the distinguished Engineer-Chemist of the Paris Gas Company contested M. Grebel's statement in regard to the yield of pure water gas consumed with an incandescent burner. He said M. Grebel's assertion that the yield of an Auer burner in volume was correct; but if it was reckoned at per 1000 calories it was not, as account had to be taken of the hourly consumption; and then the speed of the gaseous current came in. The President eventually closed the discussion; and as there was an evident indisposition on the part of members to listen to any more papers, the proceedings were adjourned.

On Wednesday morning, M. Henri Laurain read a paper on the estimation of naphthalene in gas, as carried out in the Paris Gas-Works, and in conjunction therewith he described an apparatus devised by M. Sainte-Claire Deville, who explained its construction, and made a test before the audience. It was seen how the presence of naphthalene gradually reduced the size of a gas-flame till it was nearly extinguished; and then, by putting a little hot water into the apparatus, the obstruction was melted and the flame restored to its original size. [The paper is given on p. 984.]

The President thanked the author for his paper and M. Sainte-Claire Deville for his explanation of the apparatus, and then invited remarks. The first speaker was M. Freyss, who pointed out that experiments had been made by the Union des Gaz with

* It is proposed to notice M. Grebel's communication at greater length, and then a copy of the diagram referred to, which has been courteously supplied to us by him, will be reproduced.—ED. J.G.L.

the view of determinating the quantity of naphthalene in gas, at various points of the manufacturing process, by means of boiling alcohol. M. Sainte-Claire Deville asked for some particulars in regard to the mode of operation. M. Grebel stated that, according to M. Freyss, the whole of the naphthalene in gas could be taken out by a solvent at high temperature.

At the close of the discussion on M. Laurain's paper, M. Guillet submitted a rather long communication on the subject of the contamination of water in gasholder tanks. [See p. 986.]

M. Guillet's paper was followed by one by M. Lhomme on the use of coke for the production of motive power. The author is the Engineer of the Nanterre Gas-Works; and he gave the results of some trials made there with a Pierson gas generator. M. Chevalet remarked that when the purifying material is employed to purify the gases from generators, no sulphate of iron is found in it so long as it remains in use; consequently it may be made to serve for an indefinite period. In point of fact, it is revivified by the excess of air which passes from time to time with the poor gas. The sulphur is carried along, in the state of sulphurous anhydride (SO_2), which gets into the piping, and can only be arrested by a scrubber. M. Visinet put the members on their guard against accepting statements in favour of engines operated by poor gas made with coke, as they might, he said, lead to the loss of customers for ordinary gas for motive power.

M. Grebel then opened a discussion on the subject of "High-Pressure Gas and its Distribution at a Distance;" and he put upon the blackboard a diagram to which he referred in the course of his remarks. The opening was, to all intents and purposes, a paper; and it brought out a few observations from M. Casaubon and M. Foillard, to which M. Grebel replied.*

Next came the reading of the report of the Commission on Distribution, an abstract of which will be found with the reports of the other Commissions noticed elsewhere.

M. Foillard gave an abstract of his paper on the application of centrifugal apparatus to the production of high-pressure gas; but there were no remarks upon it.

In a very brief communication, M. Billon described an arrangement devised by him for preventing fraud by the tilting of wet gas-meters. It consists of a ⊢ piece attached to the outlet of the meter at the point where the service-pipe is connected. The horizontal arm of the appliance contains a metal ball which, in its ordinary position, leaves the outlet perfectly open. If, however, the meter is inclined from back to front, the ball slips into the lower division of the upright portion of the appliance, and closes the gas passage. This necessitates a visit from the gas company's officials, who at once detect the attempt at fraud. The appliance has been in use for some months at Cahors, where M. Billon has fixed about fifty with very satisfactory results. No observations were made upon the paper, the reading of which brought the sitting to a close.

The first business on Thursday morning was the reading of the report of the Committee on the Applications of Gas; and it gave rise to a few remarks. Afterwards M. Charles André described a sanitary gas-heated oven, the temperature of which can be kept at 120° Fahr. or raised to as much as 750° Fahr. The heating agent may be coal, producer, or hydrocarbon gas. The oven is suitable for baking bread or pastry, and it may be employed in all industrial operations in which a constant temperature is required. It is claimed that it gives the maximum of heat with the minimum of expense. Trials carried out by the Lyons Gas Company showed that with a consumption of 1765 cubic feet of gas the temperature of two superimposed ovens could be raised to 570° Fahr.; that the hourly consumption to maintain the two ovens at a baking temperature between 480° and 570° Fahr. was 53 cubic feet; and that the temperature of the room is not increased while the oven is in use.

After M. André came M. Picot, who, without reading the paper he had prepared, dealt with the subject of preventing escapes of gas. At the meeting of the Society at Marseilles last year, he called the attention of the members to several arrangements for avoiding escapes. One of them, to which the name of "Block Gas" has been given, was for use with warming-stoves. Certain modifications have been made in it, the nature of which was explained by the author, who also described an appliance for attachment to upright or incandescent burners with the object of preventing gas escapes.

M. Bertin followed with a summary of a long and rather important communication on the subject of heating by radiation, and described the new radiating bars devised by M. Clamond.

M. Grebel gave summaries of two short papers. In accordance with a promise made at the meeting in Paris two years ago, he furnished particulars of the economizing reflector which he then brought under the notice of members. He first of all explained the object of the reflector, and then gave particulars of the trials of it, and showed that it is 50 per cent. better than an ordinary reflector. The superiority of a lamp furnished with one of these reflectors over an ordinary lamp was stated to be upwards of 120 per cent. The other paper by M. Grebel contained some particulars of a self-lighting tap, named the "Fulgo," working with ferro-cerium, which was shown in action in the entrance hall.

A few remarks were then made on the subject of lignite and other materials for the production of illuminating gas. It was introduced by M. Rolland d'Estape, who stated that at Marseilles some trials had been made with lignite; and the result was unfavourable to having supplies of this material on gas-works, as it readily took fire. The gas produced was of an exceedingly variable character, and had no illuminating power. The coke was very poor, and there was only a little of it, with a good deal of ash, which was sometimes nothing but dust. M. Chevalet referred to a material, having some of the properties of peat, which he said he had tested superficially; but its character was not very clearly defined.

This brought the technical business of the congress to a close.

There were two papers on the programme which were not read. One was by M. Besnard, in which he described a machine for charging retorts by means of two scoops manipulated by one stoker; and the other by M. Faucher, on the production of ice in gas-works. [The details of M. Besnard's machine will be given in connection with some other papers next week.] The system described by M. Faucher was that of the Raoul Pictet Company, whose plant was illustrated in his paper. It appears that the manufacture of ice is already carried on in several gas and electricity works in France; and a large installation has been put up at Beyrout, where there are three machines at work, the first having been started in 1884. At Barcelona, the Central Catalana Electricity Company have in use two machines producing 24 tons of ice, the return from which compensates for the smaller demand in the summer for motive power for the production of electric energy. According to the figures given by the author, there would be a return of 27,000 frs. for an outlay of 10,830 frs. He submitted the subject to the members as one worthy of their attention, with the view of adding the manufacture of ice to their present business.

Visit to the Gas and Products Works at Le Landy.

On Wednesday afternoon, the members visited the gas and products works of the Paris Gas Company at Le Landy. The gas-works were described and illustrated in the "JOURNAL" on the occasion of the visit in connection with the meeting of the Society in Paris in June, 1910.* It was then mentioned that there would be something more to see when the members came again; and they found this prediction verified. The line of coke-towers has been extended by the addition of twelve, making twenty-four in all. The fine station-meter house has been completed, and now contains thirteen meters. Conspicuous features of the extensions are the two three-lift gasholders which were in course of construction two years ago. They are each capable of holding about 5¼ million cubic feet of gas; and the foundations are being laid for a third. When this is erected, there will be altogether eight holders at this station—bringing up the storage capacity to 21¼ million cubic feet.

The members were conveyed by special train from Paris; and on reaching Le Landy they were received by M. Rouland, the Managing-Director of the Company, who offered a few words of welcome. They were then divided into parties, and conducted by members of the staff through the various departments of the station, beginning with the coal-receiving arrangements, until they reached the new holders, some particulars of which are given below. There they found the train drawn up to convey them to the products works which have been commenced on the land acquired by the Company for the new Cornillon works adjacent to those at Le Landy. The building actually completed and equipped is for the treatment of the ammoniacal liquor for the manufacture of sulphate of ammonia. Its spaciousness, fine proportions, and the quality of the sulphate produced in it were subjects of comment by the visitors. It is intended to enlarge the house so as to deal with all the liquor produced at the two stations in this locality. The manufacturing capacity of the existing works at Le Landy is about 24¾ million cubic feet per 24 hours; and the daily production of ammoniacal liquor varies between 33,000 and 44,000 gallons. The corresponding production of sulphate of ammonia is 5000 metric tons per annum. The new building is situated by the side of the St. Denis Canal, and is connected to the Northern of France Railway by the branch line used for the works at Le Landy. The two stations are separated by the high road from Paris to Calais, which is crossed by the line.

The holders above referred to are 242 ft. 9 in. diameter, and stand in steel tanks. With the view of giving them good foundations, the ground was excavated to a depth of 13 feet, and lined to the thichness of 12 inches with ferro-concrete covered with a 2-inch layer of sand. The bottom of the tank in each case rests upon this bed of concrete, and there is a ring of masonry 8 feet wide and 246 feet outside diameter under the sides of the holder. When full, the tank holds about 12 million gallons of water. The diameter of the inner lift is 233 ft. 9 in.; of the middle lift, 237 feet; and of the outer lift, 240 feet—the depth of each being 41 feet. The holders are supported by 32 standards, 165 feet high and 5 ft. 7 in. wide, riveted to the tank and firmly braced together. The guide-rollers are radial and tangential. The holders are filled from an above-ground feeder, 4 ft. 7 in. diameter, supported at intervals by pillars. At one end, this feeder is furnished with two pipes, about 3 ft. 3 in. long, which convey the gas into the holder; the outlet being on the opposite side. The holders are furnished with the vertical scale and dial usually seen on the Continent to indicate the quantity of gas contained in them. To prevent the tank water from freezing, there are in an

* A summary of M. Grebel's remarks, accompanied by the diagram, will appear in a subsequent issue.—ED. J.G.L.

* See "JOURNAL," Vol. CXI., p. 184.

adjoining building three boilers, each providing a ton of steam per hour. Flexible pipes conduct the steam to the tanks, grooves, and Körting injectors, which keep the water at 40° Fahr. even when the temperature is very low indeed. Each of the holders weighs about 2850 metric tons.

Banquet and Excursion.

The usual banquet of the Society was held on Wednesday evening, in the restaurant of the Grand Hotel. The President was in the chair, and he had on his right M. Guillain, representing the Minister of Commerce and Industry. After the toast of "The President of the Republic," M. Marquisan delivered a short address, and concluded by proposing the health of his successor in the presidency (M. Boutan). The new President, in responding, spoke highly of M. Marquisan, and thanked him for all he had done. In the course of his address, M. Marquisan alluded in terms of praise to the work of the Paris Gas Company; and due acknowledgment was made by M. Rouland, who concluded his remarks by drinking to the health of the retiring and the new Presidents, and prosperity to the Société Technique du Gaz. The customary toast of "The Health of the Past-Presidents" was responded to by M. Ancel, to whom was presented the bronze medal awarded by the Committee, to which reference has already been made, and for which he expressed his thanks. The other medal was awarded to M. Albert Ellissen, in whose absence it was received by his son. M. Guillain, in the course of an interesting speech, expressed the goodwill of the Minister of Commerce towards the Society, and his pleasure in sending a representative to distribute the medals to the workers. He referred to the improved conditions under which men now carry on their duties in gas-works, and conveyed the appreciation of the Minister of all that is being done to ensure the health of the workers in a business which is not salubrious. In the course of the proceedings, some felicitous references were made to the union of gas and electricity supply undertakings, as exemplified in the cases of the Companies with which the Past-President and his successor, as well as M. Ancel, are associated—viz., those at Marseilles and Lyons; and hope was expressed that the application of the two systems of lighting would continue. Toasts were proposed for the development of these and other industries. The banquet, as usual, was the occasion of a pleasant gathering of professional colleagues.

On Thursday, at the close of the Congress, a large number of the members, in some cases accompanied by ladies, were conveyed in motor omnibuses to Versailles, where they partook of luncheon, and visited the aviation ground at Buc, to witness a demonstration of flying-machines which had been arranged for the occasion. On the return to Paris, they separated with many hand-shakes, and looked forward to a pleasant reunion at next year's meeting, which, in accordance with custom, will be held in a Provincial town.

Before concluding these notes, acknowledgment must be made by the writer of much assistance received from the Permanent Secretary of the Société Technique (M. Henry Bouron) and others to whom it is unnecessary to refer personally. To all, his sincere thanks are tendered.

Deterioration and Spontaneous Heating of Coal in Storage.

In an article in the "Journal of Industrial Engineering Chemistry, Messrs. H. C. Porter and F. K. Ovitz refer to an investigation on this subject which was conducted by the United States Bureau of Mines. With New River coal, which is largely used by the United States Navy, there was a loss of less than 1 per cent. in calorific value (calculated to "coal substance free of moisture, sulphur, and corrected ash") when a 300-lb. sample was exposed in the open air for a year. There was practically no loss in samples submerged in sea water or in fresh water. Pocahontas "run-of-mine" coal, a steaming and coking coal, which is the principal fuel used in the Panama Canal work, lost less than 0·4 per cent. in calorific value by exposure for one year. Pittsburgh coal, a rich coking and gas coal, suffered no loss in calorific value by exposure for six months. Wyoming coal, a sub-bituminous coal or black "lignite," lost 5·3 per cent. of its calorific value in 2¾ years, and as much as 3·5 per cent. during the first three months' exposure. Storage under water prevents loss of calorific value; and, as it also prevents spontaneous combustion, it may be advantageously adopted in some cases. But there is the great disadvantage that some kinds of coal retain a large proportion of water after draining; and fuel would be consumed to evaporate this water. With regard to the spontaneous combustion of coal, these suggestions are made: (1) Coal should not be piled more than 12 feet deep, nor so that any point in the interior will be more than 10 feet from an air-cooled surface. (2) If possible, lumps only should be stored. (3) Handling of the coal should be reduced to a minimum, to avoid making dust. (4) Lumps and fines should be distributed in the pile as evenly as possible, taking care that the lumps do not roll down and form air passages at the bottom. (5) The coal should be rehandled and screened after two months. (6) External sources of heat should not be allowed near the pile. (7) Coal, after mining, should be "seasoned" for six weeks before storing in piles. (8) Alternate wetting and drying of the coal should be avoided. (9) Admission of air to the interior of the pile through interstices or porous foundations should be avoided. (10) Ventilation by pipes should not be attempted.

AN ELECTRICAL CONTEMPORARY ON ELECTRIC COOKING.

A Search in the Land of Imagination for an Answer to a Plain Question.

THE "Electrical Times" has devoted some two-and-a-half columns of its space to an attempt to educate the "JOURNAL" on the elementary principles of gas and electric cooking; the soul-stirring cause of the benevolent exercise being a direct question that we put, in our issue of the 4th inst., to the contributor of "Installation Topics" in our contemporary. The two-and-a-half columns of consummate ignorance of proper-method gas cooking published by the "Electrical Times" are intended to dispose of the plain question; and so strong is the belief of the responsible person in the cloud of curious reasoning to which he has treated the matter that a type-written postcard was sent to us calling attention to the pages of our contemporary on which the article appears, in case we should overlook the heavy type-line heading, "'THE JOURNAL OF GAS LIGHTING' and Electric Cooking." The postcard is redolent of egotism.

The question we put to the writer of "Installation Topics" was this: Take two joints of the same weight and the same constitution, put one into a gas-oven and the other into an electric-oven at the same temperature, remove them from their respective ovens when they are equally cooked, and what is there about the electric-oven that should make it save half to two-thirds of the loss of weight of meat sustained in the gas-oven, or what is there about the gas-oven that should make it cause the meat to lose half or two-thirds more in weight than the electric-oven? As we said, there must be an explanation—and a scientific one—if it be true that the electric-oven has an effect of this kind that is peculiar to itself, and cannot be obtained by any means in the gas-oven. The question is a plain one; but there is not a straightforward, scientific explanation forthcoming.

The fact is our contemporary cannot give an explanation; and therefore it falls back in its educative essay upon imagination. "We *imagine*," says our would-be instructor, "the reasons to be quite simple and elementary." Now for these simple elementary reasons:

> The gas-oven necessarily must be open to the air top and bottom to provide correct burning conditions for the gas inside. There is consequently a vigorous movement of the internal atmosphere; air at the temperature of the room being drawn in underneath and expelled, in a greatly heated condition, and richly charged with grease, vapour, and unpleasant impurities of all kinds, by way of the flue at the top. It is well known that meat, whether cooked or raw, loses weight rapidly in a current of air, and more rapidly still in a current of heated air. The loss is chiefly that of the volatile constituents of the meat, and in a gas-oven the natural juices, without which the meat has little value as a food, instead of being retained, are evaporated and lost up the flue. But it is not the moisture alone which is wasted, the fat is vaporized, and a large percentage accompanies the moisture through the vent, and is deposited, as it cools, in a film of grease upon the adjacent walls, shelves, and articles in the room. Wherever a gas-oven is installed, this surrounding film of grease is an invariable accompaniment; and it is instructive to remember that the user has paid for this waste at the rate of 10d. to 1s. per pound.

That is indeed very "simple" and very "elementary." It suggests a sort of air-blast condition in a gas-oven. There is a "vigorous movement of the internal atmosphere; and the air is drawn in and expelled"—that is, sent out with great force. We asked for a scientific explanation of the extraordinary meat shrinkage attributed to a gas-oven. Now if this simple and elementary explanation is correct, it follows that, as the length of travel through the oven is not a great one, it would be impossible with such a vigorous transmission and expulsion of the air, for the viands in the oven to cook at all. Nothing is allowed by this imaginative person, in dealing with the conditions existing in a gas-oven, for the baffling action of the shelves in the oven and of the dishes containing the food being cooked. If there is this extraordinary rush of air through the oven at initially atmospheric temperature, especially in the winter months, the oven would have some difficulty in getting hot at all. A little later on, our instructor has to try to make out a case for the wickedness of the gas-oven—according to the distorted notions of the electrician, but not according to the experience of hundreds of expert cooks and hundreds of thousands of users—in refusing to submit to proper heat regulation. This is what is said:

> The gas-oven, being built up of masses of cast iron, and heavily lagged to reduce heat losses, is not able quickly to respond to alterations in the heat control; and consequently retains an internal temperature much in excess of requirements, in spite of the gas-tap being turned down. Anyone with experience of gas-cooking knows how difficult it is to adjust, except at haphazard, the size of the gas-flames in an oven, or to get uniform results from several consecutive bakings.

This is an excellent testimonial to the heating power of gas. Now if there is this remarkable conservation of heat in the gas-oven (which in itself is something valuable from the standpoint of economy), it shows that there cannot be that express heat-absorbing rush of air through, and expulsion from, the oven which our "simple" contemporary finds is the "elementary" explanation—pardon, we should have written "simple and elementary" explanation. Our friend must either give up the air-blast action or the extraordinary heat storage of the oven before we can admit

even the semblance of a sound scientific theory. The two theories, as they stand, are not compatible.

So far, we have no disproof of our contention that it is possible to regulate the temperature of a gas-oven so as to (approximately) lose nothing in the weight of a comparable joint more than in an electric oven working at equal temperature, and the meat cooked to the same degree. We go farther into our contemporary's article, which presumes to assert that our thirty years' experience—which experience is altogether contrary to the assumptions of the writer in our contemporary—is all a mistake, and that the postulation in the cause of electric cooking must be set above that long experience of gas cooking, through which no one with whom we are acquainted has suffered from any of the evils at which there are dark hints. However, there is the question of temperature regulation. In an electric-oven, there are three or four fixed temperatures. There is nothing between them, excepting for the short time after there has been a change from one temperature to another. In a very short time after a change-over, another set condition of temperature is obtained, from the operation of the full-on, three-quarter-on, half-on, or quarter-on switches. One cannot say that these fixed limits of, and degrees in, temperature put into the hands of the cook the power of temperature regulation necessary for the hundred-and-one different articles that have to come under the influence of temperature in the oven. The writer in our contemporary assumes that an "excessively high cooking temperature" is a normal and unalterable condition in the gas-oven. It is really too absurd to discuss such foolish assumption as this, when a world-wide experience tells a contrary tale; when we know that a user of a gas-oven gets as accustomed to its regulation as a violinist does to the ready tuning-up of his instrument. However, this is what is said:

> One result of excessively high cooking temperature is that, although the protective coating to the meat is formed at first, being subjected to a continuance of the heat, it soon cracks, and allows the moisture to escape into the tray beneath or to evaporate. This, coupled with the continual passage of highly heated air currents through the oven, causes the waste which our contemporary cannot understand.

There, again, we have no explanation of the extra waste attributed to gas-ovens. We did not put a case to our contemporary of an "excessively high cooking temperature;" we spoke of equal temperatures in a gas-oven and an electric-oven, which is a condition that it is quite easy to obtain. Cannot our contemporary treat the matter on common-sense lines, and not suggest that all users of gas-ovens are incompetents and unintelligent. The person who thinks so, or who suggests it in his writings, invites his character to be summed up in a simple, expressive, four-lettered word.

Then we get another peculiarity ascribed to the gas-oven. In one place we are told that the masses of cast iron and lagging of which the oven is constructed forms an excellent store for heat. Now we read that "since the heat of the gas-oven is entirely from underneath, it is impossible, without frequent basting and turning of the joint, to secure equal even cooking. How can the heat all come from underneath when there is a large amount stored in the casing and lagging? Which means that heat must be transmitted from all parts of the oven casing. Our teacher must study more the question of heat transmission in a gas-oven before he affects to spread himself out again in monition of this absurd character, which point by point contradicts itself. In the case of the electric-oven, he says, the heating elements are placed top and bottom, and can be regulated independently. This being so, is it necessary to turn a joint in such a heated oven (we take it he is speaking here of an unlagged electric-oven) so that it is brought *vis-à-vis* on all sides with the two heating elements? The heating element at the bottom must suffer from the escape of the juices from the joint; or is there some providential interception of the juices, to supplement the other wonderful concessions to electrically generated heat that enthusiastic electricians have discovered in the fertile land of imagination? A worse farrago of contradictory statements on the subject in hand, we have never met with than in this "Electrical Times" article, in which the writer "imagines" the reasons to be "simple and elementary."

Further to the subject of ventilation. The same writer says that in the sinless, moisture-preserving electric-oven, "the meat hangs or lies in a constant atmosphere, the *currents* of which merely *circulate* at the correct temperature throughout the interior, *and do not pass away at all.*" Now we put it to the writer in our contemporary how, in an enclosed vessel, from which the air does not pass away at all—with, as the temperature and humidity of the air increase, the pressure inside the hermetically enclosed vessel rising—"currents" of air can "circulate." Of course it is superfluous to talk of "currents" "circulating"—they would not be currents if they were motionless. But do the currents exist under circumstances that are opposed, if description is correct, to their existence? That is another flaw in this "simple and elementary" argument, and scientific explanation is still absent. Still on the point of ventilation, and the hermetically sealed electric-oven. At the recent Smoke Abatement Exhibition, there were seen electric-ovens with a vent at the top; and the vent is absolutely necessary if baking of pastry is to be done in the oven. Cooks who have tried unventilated electric-ovens have complained that they have found it very difficult to get anything properly cooked in the way of pastry and other things, owing to the humidity of the atmosphere; and we can imagine that pastry from such ovens is often exposed to shocks other than electric when its condition is inspected. However, the argument of our electrical friend will not apply to the ventilated electric-oven.

There is another point about the non-ventilated oven. At the exhibition just referred to, one of the ladies supplying visitors with explanations in the electric department, asked whether enclosed tins used in gas-ovens (which our contemporary completely ignores throughout its "simple and elementary" argument) are ventilated? The answer was in the affirmative. There is a small ventilating regulator in each one. The lady then voluntarily gave the reason for the inquiry that, as meat gives off in cooking poisonous fumes, unless the tin was ventilated, the meat would be cooking in an atmosphere of poisonous fumes, just as in the case of the meat in a pie without vent through the crust. The assurance was given that an unventilated meat pie was very detrimental to health. The lady was asked if this was the case, what had she to say to the small unventilated electric-oven, hermetically sealed (such as the writer in the "Electrical Times" refers to), from which air "does not pass away at all." All she could reply was that, in some electric-ovens, there was larger capacity than in others. But that is no answer to the point which the lady—an electric cooker advocate!—herself advanced as to the meat being cooked in a poisonous atmosphere.

Now so far there is nothing presented that will stand the test of examination, and supply a sound answer to our question. Let it be remembered that the electrical people have never yet come out into the open, and had their cookers independently tested for over-all cooking efficiency in comparison with modern gas-ovens with the correct methods of using them applied. They have never had the electric oven, for instance, tested, as might have been done, with a gas-oven in which a simple enclosed tin is used, which tin can be purchased for a modest sum (2s. or 3s.), and which does away with the bulk of the statements advanced by the "simple and elementary" article. Slow cooking can be indulged in in the ordinary open gas-oven. With the enclosed tin, no basting is needed; and there is no splashing of gravy on to the sides of the oven. The meat in short is not exposed in any way. Thus our friend can see how simple is the expedient for curing the ills and evils that he suggests are the inseparable concomitants of gas-cooking. This is the choice manner in which this point is dealt with:

> Deliberately to subject meat—intended subsequently to be eaten, presumably with enjoyment and profit—to direct contact with a naked bunsen flame and its poisonously foul products—to say nothing of the influence of the hot, decomposing vegetable and animal matter absorbed in the lagging—is to commit a crime against the most primitive laws of common sense, hygiene, and science. It is no answer to ask us to point to a clear case of death caused by poisoning set up by gas-cooked food, for the human system can get accustomed to systematic doses of very pronounced poison, which may never go so far as to kill. That habitual consumers of gas-cooked joints would be far better in health if the meat were cooked in a pure atmosphere [Is it pure?], so that no deleterious products from the oven could possibly be passed on *viâ* the joint to the eater's system, cannot be doubted. A poison is none the less a poison because its action is slow, and seldom, if ever, causes death.

Upon this let us ask, Is it fair to suggest "poison" without putting a name to it? In the first place, the meat is not subjected to "direct contact" with naked bunsen flames; in the second place, what are the "poisons" that are given off by an atmospheric gas-flame? The writer in the "Electrical Times" must be hard up for argument if he has to sink into slander of this kind to bolster up a case against the gas-oven. Here we have free-burning bunsen flames. We ask again, lest it should be conveniently overlooked, what are the "poisons" which emanate from them? He tries to make his point, and then to sneak away from it, by saying: "A poison is none the less a poison because its action is slow, and seldom, if ever, causes death." Such tricks are not creditable in serious controversy.

Then there is the statement: "To say nothing of the influence of the hot decomposing vegetable and animal matter absorbed in the lagging," &c. In another place, the lagging is described as "wood-wool lagging." We want to know more about this "hot decomposing vegetable and animal matter." In one part of the article the volatile products of the meat baked in a gas-stove are forcibly expelled by the violent currents of air passing through the gas-oven; in another part (when not using enclosed tins), the volatile products are plastered on the sides of the oven, so that a considerable amount of labour has to be expended on it; and now we see that the lagging of the gas-oven absorbs a quantity of these volatile products, and they decompose—and we are not dead after thirty years' use of the gas-oven! How great and manifold are the wickednesses of the gas-oven! But about the expenditure of time on the cleaning of the interiors of gas-ovens. There is no necessity for this if an enclosed tin is used; but in an electric-oven does not meat spit and give forth volatile products the same as when meat is submitted to the cooking temperature in ovens otherwise heated? A friend not a great while ago on a visit to inspect some electric-ovens was told by the lift-boy that he had plenty to do, besides attending to the lift, in cleaning the insides of demonstration ovens and the heating elements from the greasy mess that got caked on them. As to the vegetable and animal matter absorbed by the lagging. Many electric-ovens are lagged; and if such matter can get to the lagging of a gas-oven, so it can to the lagging of electric-cookers. It is an interesting assertion; it has been made before. The lagging employed for gas-ovens is slag wool. Over it is an enamelled sheet-iron casing. No vegetable or animal matter can get through this enamelled sheet-iron.

The only possible place that it could penetrate is at the joints of the casing; and if it gets through there, then there is crude construction. Now we have a cooker at the present time that has been for over eight years in daily use for all the cooking—baking, boiling, grilling, &c.—required by the household, without any interruption, and not a penny spent upon repairs; and there are none of those poisonous fumes from it that are ascribed to the bunsen flame, or to the lagging. Will our contemporary kindly give a reason for its absence? There is also more explanation required in respect of the lagging—in the interests not only of lagged gas-ovens but of lagged electric-ovens. We have seen lagging that is discoloured by heat; but that does not represent the accumulation of decomposing vegetable and animal matter about which the writer in the "Electrical Times" speaks.

There are many minor points in the inconclusive, contradictory article; but we have said enough to show the hollowness of the "simple and elementary" case put forward by our contemporary. Its attempt at instruction is an extremely grotesque one. But two small points in conclusion. We are not bound by any figures issued by any gas company. Our own experience and certified data in hand are sufficient for us. Nor is the "JOURNAL" the author of "the error that it is more economical to cook a small joint than a large one in an electric-oven." It was pointed out that the figures in the "Electrical Times" referred to by us on June 4 in "Electricity Supply Memoranda" suggested that this was so.

Will the "Electrical Times" answer categorically the question, Is it impossible to obtain from a gas-oven, by the methods available, approximately the same weight of meat as from an electric-oven, given equal weight of meat in the raw state, similar constitution of meat, equal cooking, and equal temperatures?

A HAND PHOTOMETER.

AT the Meeting of the London Section of the Society of Chemical Industry on Monday last week, Mr. W. J. DIBDIN showed a new form of "Hand Photometer," which he had described in a paper that should have been read at the meeting. Priority had, however, been given to a lengthy and interesting paper by Professor W. H. Perkin, F.R.S., dealing with the synthesis of india-rubber in England, on which a long debate ensued. Consequently, owing to lack of time, Mr. Dibdin did not read his paper at length, but briefly described his hand photometer.

Mr. J. H. COSTE said that the photometer had the advantage of great convenience, and ready portability. It could be used in the street without attracting attention. The adoption of the Leeson disc rendered the instrument available for testing lights varying greatly in colour.

Mr. JACQUES ABADY said that he could, from personal experience, support Mr. Dibdin's statement as to the accuracy of measurements made with this photometer.

The CHAIRMAN (Mr. E. Grant Hooper), after referring to the convenience and relatively low cost of the instrument, moved a vote of thanks to Mr. Dibdin for his paper.

A DESCRIPTION OF THE APPARATUS.

The following is a description of the apparatus, which may be seen in the show-rooms at Westminster of Messrs. Alexander Wright and Co., to whom Mr. Dibdin has entrusted the manufacture of it.

The photometer consists of a rectangular box, about 17 inches long by 5 inches wide and deep, at one end of which is a Leeosn star disc, arranged with mirrors, just like the disc box used on the standard gas-testing photometer. The illustration shows one-half of the disc-box, and it also shows the door of the photometer itself opened, so as to disclose the interior. It will be seen that in the interior is a lamp L. This is a glow lamp, and is fixed exactly 1 foot from the disc. It is supplied with current from the 4-volt cells shown; and the connections from the cells to the lamp are made through an open wound resistance, which is fixed to the underside of the top of the box. A sliding-contact B, with press-button C, is moved along the resistance, thus varying the current of the lamp, and consequently the illuminating power. A scale S is fitted on the top of the box; and it will be seen that the amount of resistance it is necessary to introduce in order to supply a light of a given candle power can be readily determined by comparison with the standard lamp. This is done before the photometers are sent out; and the scale is therefore graduated in foot-candles.

That the basis of this photometer—namely, the relationship between current and illuminating power for a given lamp—is one that is well recognized, will be seen by those of our readers who refer to the report on Street Photometer Tests made by the National Physical Laboratory which was given in the "JOURNAL" (together with an illustration of the apparatus employed) on May 2, 1905, p. 287. The scale runs from 3 to 0·001 of a foot-candle. For higher illuminations the lamp is placed in the second position, L1, 6 inches from the disc; and therefore the scale readings are multiplied by four. A small voltmeter V is fitted, and a certificate with the photometer states the voltage that has been found requisite to give candle powers at certain points of the scale. It will thus be seen that the efficiency of the cells can at any time be tested by observing the voltmeter readings; while the only variation that would take place in the foot-candle readings on the scale would be due to a drop in the efficiency of the lamp. This, of course, can be checked by a standard photometer as often as is necessary, and the scale shifted.

The photometer can be used by pointing it direct at the light, and direct measurements can be taken at any angle, which the quadrant Q enables the reader to observe. For diffused illumination or illuminating effect, the photometer is used with the front of the disc box opened, and the illumination in the horizontal or any other plane is read direct in foot-candles. For horizontal readings the photometer can be stood on its end.

Dibdin's Hand Photometer.

The star disc is used because this to a very great extent eliminates colour difficulties. A large number of readings made with this hand photometer and with a standard photometer fitted with a "Flicker" disc gave very closely concordant results. Some idea of the range of the photometer may be gathered from the statement that, with the electric lamp at 6 inches from the disc, if the photometer were 25 feet from a source of light over 7000 candles in power, a balance or reading could be obtained.

From this description it will be evident that the Dibdin Hand Photometer provides a simple and ready means for ascertaining direct or indirect illumination, and that it can be checked and kept in a condition of accuracy without any difficulty, and without the employment of any other law than the law of inverse squares.

The Seventh Annual Joint Meeting of the Manchester and District Junior Gas Association with the Yorkshire Junior Gas Association will take place next Saturday, when a visit will be paid to the Rockingham Chemical-Works of Messrs. Newton, Chambers, and Co. After the inspection the visitors will be the guests of the firm at tea.

THE FORMATION OF SULPHURETTED HYDROGEN IN IRON SERVICE PIPES.

By J. G. Taplay.

There are several ways by which purified coal gas may become contaminated by sulphuretted hydrogen. One of these is commonly mentioned in text-books on organic chemistry, and relates to the reaction between carbon bisulphide and ammonia. The writer has shown that carbon bisulphide and water will also react with each other and produce sulphuretted hydrogen. The quantities of carbon bisulphide, ammonia, and water vapour contained in coal gas being, however, very small, traces only of sulphuretted hydrogen are produced by these means. Further mention of them therefore need not be made.

A little more than six years ago, the writer showed that sulphuretted hydrogen could be formed in the tank-water of gas-holders by bacterial processes, and in such large quantities as to blacken, in a few seconds, a paper impregnated with a solution of lead acetate. The purpose of the present article is to show yet another way in which sulphuretted hydrogen may be, and often is, formed, and to record some experiments which were made by the writer during his investigation into the cause of its formation.

To commence with, it is necessary to mention the circumstances which led to the investigation being undertaken. The Gaslight and Coke Company's City Laboratory is situated on an upper floor of a building in Tudor Street, Blackfriars. The ground floor of the building is employed as a valve-house for controlling the pressure of the gas supplied to a portion of the City; while a part of the basement beneath is walled off from the gas-mains and employed as a compressor-house in connection with the high-pressure gas-lighting installation in the City. The gas-service to the laboratory rises vertically from the main on the outlet side of the district governor, and is composed of tin-lined lead, of 1 inch in diameter. This service does not enter the compressor-house at all. A Gas Referees' sulphuretted hydrogen test (impingement and dry papers) apparatus is fixed on a branch from this service-pipe. There are two wrought-iron gas-service pipes, each ½ inch diameter, which run from the inlet side of the district governor to the valve-house above. One passes along the ceiling of the compressor-house and is used to convey gas to a Referees' sulphuretted hydrogen test (impingement and dry papers) apparatus, and the other, which does not enter the compressor-house, is employed to convey gas to a jet photometer.

The compressor-house is lighted by gas on the high-pressure system; and as the ceiling is rather low, the upper air becomes hot when the gas-engines and the lights are working, notwithstanding that there are a large shaft and fan employed to carry away the waste air. A few days after the high-pressure installation had commenced working, the lead-acetate test-papers in the valve-house sulphuretted hydrogen test apparatus showed dark stains, which proved to be due to sulphuretted hydrogen; while at the same time the test-papers in similar apparatus fixed on the tin-lined lead pipe in the laboratory showed no stains. This was repeated daily, with similar results. Another sulphuretted hydrogen test apparatus of the same type was then fixed on to the wrought-iron service-pipe conveying gas to the jet photometer; but the test-papers here always remained clean.

Thinking that the production of sulphuretted hydrogen in the iron service-pipe, which runs across the ceiling of the compressor-house, might be due to some local deposit, the writer had this pipe, and also that to the jet photometer, washed internally with hot water, followed by several charges of gas under pressure supplied from a force-pump. Sulphuretted hydrogen test-papers were afterwards placed in the test apparatus, and for one day they remained clean. On the following day, however, they again showed heavy stains, due to the presence of sulphuretted hydrogen, and continued to do so daily; whereas gas from the other iron service-pipe and from the tin-lined lead pipe, previously mentioned, showed no trace of sulphuretted hydrogen at any time.

Obviously, there was some particular condition set up in this iron service-pipe crossing the ceiling of the compressor-house which was non-existent in the other two service-pipes. Firstly, the temperature of the air near the ceiling of the compressor-house in the neighbourhood of the iron service-pipe was observed on several occasions, because it was thought to have some part in setting up the necessary conditions. The observed temperature varied from 90° to 158° Fahr.; the temperature in the neighbourhood of the other two service-pipes previously mentioned was found to be normal—*i.e.*, about 60° Fahr. That temperature well above the normal is one of the factors necessary to the formation of sulphuretted hydrogen in this manner seems to be suggested by the fact that on the few occasions when the gas-engines and lights were not at work in this compressor-house the test-papers showed that the gas in this particular service-pipe was free from sulphuretted hydrogen; but the latter again appeared soon after the gas-engines were started to work. It need hardly be stated that another factor necessary to the production of sulphuretted hydrogen is, of course, carbon bisulphide, which all ordinary illuminating gas contains to some small extent.

At this point, the investigation was transferred to the laboratory; so that the experiments could be brought under better control.

(*a*) The first experiment consisted in procuring three tubes, one each of wrought-iron, tin, and glass, each of ½ inch diameter and 5 feet in length. Each tube was heated to a temperature not exceeding 158° Fahr., and ordinary illuminating gas, quite free from sulphuretted hydrogen, was passed through each tube at the same rate of consumption per hour, and made to impinge on papers impregnated with lead acetate at as near as possible the same velocity. The results, repeatedly obtained, are as follows:—

1.—Iron tube, sulphuretted hydrogen indicated in about 30 minutes.
2.—Tin tube, no sulphuretted hydrogen after 25 hours.
3.—Glass " " " " "

It may be here remarked that, in order to produce sulphuretted hydrogen in the glass tube, it was necessary to heat the gas to a temperature of 1112° Fahr. The tin tube was also heated to a temperature of 440° Fahr., which is just under its melting-point, but no sulphuretted hydrogen was produced. This experiment appears to show that wrought-iron assists in some way in the formation of sulphuretted hydrogen, but tin and glass do not.

(*b*) To ascertain whether wrought-iron does assist in the formation of sulphuretted hydrogen, the above-mentioned tin and glass tubes were each packed with 3 feet lengths of thin, black wrought-iron wires, each tube was heated as before, and illuminating gas, free from sulphuretted hydrogen, was passed through each tube and made to impinge on the test-papers exactly as in the previous experiment. No sulphuretted hydrogen was indicated by the test-papers even after several days. The wires were then removed, polished, and replaced in the tubes, with the following results:—

1. Tin tube and wires, sulphuretted hydrogen indicated in 7 hours.
2. Glass tube and wires, sulphuretted hydrogen indicated in 40 hours.

The reason why the tubes packed with the black iron wires did not indicate, by means of the test-papers, the presence of sulphuretted hydrogen, is possibly because that gas, being in very small amount, was absorbed by the coating of black oxide of iron on the wires. It will be observed that there is a great difference in the time taken to indicate the presence of sulphuretted hydrogen when employing the polished iron wires in the tin and glass tubes. This is probably caused by the tin tube being a better conductor of heat than the glass tube, and therefore gas passing through the latter tube would not be raised to a similar temperature to that passing through the metal tube, though the initial heat applied was the same in both cases.

(*c*) Commercial metallic iron, either in the form of wrought-iron or cast-iron, contains sulphur in the form of metallic sulphide. Some experiments were therefore made to ascertain if this metallic sulphide could be decomposed at such a temperature as that employed in the previous experiments—viz., 158° Fahr.—when illuminating gas was passing over it. Sulphide of iron occurs principally in three forms: (1) Iron sulphide (FeS); (2) iron disulphide (FeS_2); (3) iron trisulphide (Fe_2S_3). The first combination cannot be decomposed in the presence of hydrogen; but the second and third forms can be so decomposed, with formation of sulphuretted hydrogen.

Iron disulphide and iron trisulphide were separately heated to the temperature of boiling water (212° Fahr.) in a glass tube, and illuminating gas was passed over the metallic sulphides. But at this temperature no sulphuretted hydrogen was indicated by the test-papers. This gas was, however, formed at a temperature of 464° Fahr. Iron rust which had been "sulphided" by means of sulphuretted hydrogen in the presence of the vapour of ammonia, when heated in a glass tube in a stream of illuminating gas did not give off sulphuretted hydrogen at the temperature of boiling water, but did so at a temperature of 248° Fahr.

This experiment proves that the formation of sulphuretted hydrogen in the wrought-iron service-pipe is not due to the decomposition of any iron sulphide which may be present, accidently or otherwise.

(*d*) The next set of experiments were made in order to ascertain which of the constitutents of the illuminating gas mixture was responsible, in conjunction with wrought iron, temperature (above normal), and carbon bisulphide, for the production of sulphuretted hydrogen. It need hardly be stated that carbon bisulphide is necessary to the production of sulphuretted hydrogen; the former being the source of the sulphur required for the latter compound.

1.—*Ammonia.*—The illuminating gas was passed through a solution of sulphuric acid to eliminate ammonia, after which it was passed through the wrought-iron service-pipe heated to a temperature of 158° Fahr., as before. The removal of the ammonia did not, however, prevent the formation of sulphuretted hydrogen and its indication on the test-papers. Clearly, ammonia has no part in this particular reaction.

2.—*Moisture.*—It is well known that a large number of chemical reactions cannot take place unless moisture is present. For instance, iron will not oxidize, or "rust," in perfectly dry air, or oxygen and phosphorus will not take fire—*i.e.*, oxidize—in air if both are perfectly dry. And, again, a mixture of perfectly dry hydrogen and oxygen will not explode; but they will explode if moisture be present. It was thought that moisture might be necessary to the formation of sulphuretted hydrogen in the wrought-iron service-pipe. The illuminating gas was therefore dried by passing through vessels containing calcium chloride before entering the wrought-iron pipe; the pipe was again heated to a temperature of 158° Fahr.; and the gas made to impinge on

a lead-acetate test-paper. No sulphuretted hydrogen was indicated on the test-paper, although this experiment was continued for nearly a week. On again passing gas not previously dried through the wrought-iron pipe, sulphuretted hydrogen was indicated on the test-paper in about 30 minutes.

In order to prove that the calcium chloride had no effect on the gas except to free it from moisture, another experiment was made where the gas passed first through the calcium chloride vessels then through a vessel containing water, and thence through the heated wrought-iron pipe. Sulphuretted hydrogen was indicated on the test-papers in about 20 minutes.

3.—*The Carrier Gas.*—In order to ascertain whether it is necessary that illuminating gas should act as the "carrier" of carbon bisulphide and water vapour, and whether its duty is solely that of a carrier, the following experiments were made: (*a*) Purified hydrogen was led through two vessels, one containing water and the other liquid carbon bisulphide, and thence through the wrought-iron pipe heated to a temperature of 158° Fahr., and made to impinge on a lead-acetate test-paper as before. (*b*) The hydrogen was dried and passed through the vessel containing the carbon bisulphide, and afterwards through the heated wrought-iron pipe.

The results obtained were as follows: (*a*) Sulphuretted hydrogen indicated by test-paper in 10 minutes. (*b*) No sulphuretted hydrogen indicated by test-paper in one hour.

To determine whether hydrogen has a part in the formation of sulphuretted hydrogen in this manner, or whether it simply acts as a carrier, experiments similar to (*a*) and (*b*) were made, except that carbon dioxide moist (*c*), and dry (*d*), was employed in the place of hydrogen, with the following results: (*c*) Sulphuretted hydrogen indicated by test-paper in 5 minutes. (*d*) No sulphuretted hydrogen indicated by test-paper in one hour.

It is thus seen that illuminating gas, which contains hydrogen, and generally carbon dioxide also, acts simply as a carrier, and that the hydrogen or hydrocarbon present apparently takes no part in the reaction. That moisture has some part in the reaction which brings about the formation of sulphuretted hydrogen, when it is heated in presence of carbon bisulphide in a wrought-iron tube, is evident from the foregoing experiments.

While these experiments with the wrought-iron pipe were being carried on, it was observed that the sulphuretted hydrogen, as indicated by the lead-acetate test-paper, was gradually becoming less in quantity, until at last it nearly ceased to be shown by the test-paper. The cause of this apparent cessation of sulphuretted hydrogen was ascertained, and it was found that the interior of the iron-pipe was coated with rust. A large quantity of this rust was removed, and on analysis it was proved that sulphide of iron was present in considerable amount. This clearly shows that the majority of the sulphuretted hydrogen formed was absorbed by the rust or iron oxide formed at the same time. Hence it failed to be indicated by the test-paper.

The iron pipe was now thoroughly freed from the rust, and moist illuminating gas was again passed through it while heated to a temperature of 158° Fahr.. In a very short time sulphuretted hydrogen was again indicated by the test-paper. It might be thought that the production of sulphuretted hydrogen, caused by passing moist carbon bisulphide through an iron pipe heated to 158° Fahr., is due to the phenomenon called "catalysis." Some examples of catalysis are: (1) Methane (CH_4) can be formed by passing a mixture of one volume of carbon monoxide and three volumes of hydrogen over metallic nickel in fine powder heated to a temperature of 482° to 500° Fahr. (2) Sulphuretted hydrogen (H_2S) can be formed by passing illuminating gas containing carbon bisulphide through a tube containing platinized pumice heated to a temperature of about 350° Fahr., as in the well-known Harcourt's colour test for carbon bisulphide.

Now "catalysis" is the decomposition of a compound, and the recomposition of its elements by the presence of a substance which itself remains unchanged. This condition is fulfilled in the examples (1) and (2) quoted above, because neither the nickel nor the platinum is changed; but it is not fulfilled in the case of the iron service-pipe. Here the iron is not acting as a catylist because it does not remain unchanged, it becomes rusty—*i.e.*, oxide of iron is formed. For oxide of iron to be formed, oxygen must have been produced; and inasmuch as moist carbon dioxide free from oxygen was used as the carrier of carbon bisulphide through one iron pipe and moist hydrogen free from oxygen was employed as the carrier of carbon bisulphide through another iron pipe, both of which became rusty, it follows that the oxygen must have been derived from the moisture present.

It is suggested, therefore, that the water vapour or moisture is resolved into its elements, oxygen and hydrogen, by electrolytic decomposition—*i.e.*, by local electric currents set up in the iron pipe and facilitated or accelerated by heating the pipe. If this is true, then the reactions between the carbon bisulphide and water vapour will be according to the following equations:—

	Water Vapour.		Hydrogen.		Oxygen.
(*a*)	$2(H_2O)$	=	$2(H_2)$	+	O_2

	Carbon Bisulphide.		Hydrogen.	Oxygen.		Sulphuretted Hydrogen.		Carbon Dioxide.
(*b*)	CS_2	+	$2(H_2)$	+ O_2	=	$2(H_2S)$	+	CO_2

That is to say, the elements of water, at the "moment of liberation" from water vapour, otherwise called their "nascent state," combine with the elements of carbon bisulphide and form sulphuretted hydrogen and carbon dioxide. That the hydrogen necessary to this reaction must be in the nascent condition is suggested by an experiment similar to (*b*), where dry hydrogen carrying the vapour of carbon bisulphide was led through the heated wrought-iron pipe without forming sulphuretted hydrogen, and by an experiment similar to (*c*), where moist carbon dioxide carrying the vapour of carbon bisulphide, upon being led through the same heated wrought-iron pipe, caused the formation of sulphuretted hydrogen in a few minutes. In order to set up these electric currents with the greatest effect, dissimilar metals are necessary, as, for instance, the thermo-couples used in pyrometry. The following are examples of thermo-couples: Platinum and platinum-rhodium, platinum and platinum-iridium, silver and constantan, copper and constantan. The thermo-couple in its simple form consists of two wires of dissimilar metals, such as those mentioned above, welded together at one end. If the junction of the metals be heated, an electromotive force is set up, which for any two given metals used is dependent upon the difference between the temperature of the heated junction and that of the free ends of the couple. If this couple be connected to an indicating instrument of sufficient delicacy, the latter will show this potential difference.

With a view of ascertaining whether metallic iron in two forms will, when joined together, be more active than when kept apart, the following experiments were made. Pieces of wrought-iron and cast-iron rod, each of about 1½ inches long and ⅜ inch in diameter, were polished. One of the rods was placed in one limb and the other rod in the other limb of a U-tube, and the whole was immersed in a bath of water kept near to boiling point. Moist illuminating gas, free from sulphuretted hydrogen, was passed through the U-tube and made to impinge on a lead-acetate test-paper. In twenty-four hours a very slight stain, due to sulphuretted hydrogen, appeared on the test-paper. A second experiment consisted in joining the two pieces of metal together and placing them in one limb of the U-tube and passing the moist illuminating gas through the tube as before. A strong stain, due to sulphuretted hydrogen, appeared on the test-paper in twelve hours.

These two experiments were repeated several times, always with the same results; and they show that to produce an activity it is not necessary to employ metals which are dissimilar, but that it is sufficient to employ a metal the composition of which is variable, and not homogeneous, like platinum. Now the composition of wrought iron and cast iron is very different; this difference being in the proportion of the constituents. The following figures show the difference between a sample of cast iron and a sample of wrought iron, in parts per cent.

Constituents.	Cast Iron. Per Cent.		Wrought Iron. Per Cent.
Carbon	2·40	..	0·30
Silicon	2·68	..	0·32
Sulphur	0·22	..	0·18
Phosphorus	0·13	..	0 09
Manganese	0·86	..	0 24
Iron	93·71	..	98·87
	100·00		100·00

In a square plate of wrought iron it has been proved by analysis that the constituents are not evenly distributed, as the following figures show:

Constituents.	Drilling from Top of Plate. Per Cent.		Drilling from Bottom of Plate. Per Cent.
Carbon	0·76	..	0·35
Silicon	0·01	..	0·02
Sulphur	0·19	..	0·04
Phosphorus	0·19	..	0 04
Manganese	0·55	..	0·51
Iron	98·30	..	99·04
	100·00		100·00

Analyses of the drillings from six equally spaced holes, drilled on a diagonal line across the wrought-iron plate, gave the following results for combined carbon, in parts per cent. No. 1 hole is at the corner, and No. 6 hole is at the centre, of the plate.

No.	Combined Carbon.
1	0·44
2	0·54
3	0·57
4	0·61
5	0·68
6	0·77

From the foregoing analyses, it would appear that there is sufficient variation in the composition of the metal to cause local electric currents to be set up when the metal is heated. It is possible that very feeble currents are always present, even when the metal is at atmospheric temperature, and that the heating merely intensifies the currents.

The following experiments are interesting, because they show that the electric current has a part in the production of sulphuretted hydrogen. The inner tube of a Liebig's glass condenser was removed and a bundle of polished thin iron wires was inserted at either end in place of the tube. The outer ends of each bundle of wires projected beyond the ends of the condenser about ½-inch, and the joints were made gas-tight by means of melted sealing-wax. The inner ends of the two bundles of wires were about 1 inch apart. The water inlet and outlet tubes of this condenser were employed as the inlet and outlet for gas. The latter was made to impinge on a lead-acetate test-paper.

(*a*) Illuminating gas containing water vapour, but free from

sulphuretted hydrogen, was passed through this tube over the iron wires for twenty-four hours, but no stain indicating sulphuretted hydrogen appeared on the test-paper.

(*b*) The illuminating gas containing water vapour was now heated to a temperature of about 158° Fahr. while passing through the same tube containing the wires, and in five hours a decided stain, due to sulphuretted hydrogen, was on the test-paper.

(*c*) A 12-volt electric battery (accumulator) was now connected to the outer ends of the bundles of iron wires inserted in the condenser, and the illuminating gas containing water vapour was passed through the tube. In this case the gas was not heated. In five hours a stain, due to sulphuretted hydrogen, was shown on the test-paper, which was not quite so decided a stain as in (*b*).

(*d*) Experiment (*c*) was repeated, but in addition the gas passing through the tube was heated to a temperature of about 158° Fahr. In five hours a very strong stain, due to sulphuretted hydrogen, was shown on the test-paper. This stain was much more pronounced than that in experiment (*b*).

(*e*) Experiment (*d*) was repeated, except that the illuminating gas was freed from moisture before entering the condenser containing the iron wires. Although this test was extended to fifty hours, no stain appeared on the test-paper.

These experiments suggest electrolysis of the water vapour and production of sulphuretted hydrogen according to the equations given on page 972. Liquids that allow an electric current to pass through them are called "electrolytes;" and the essential condition that they should transmit a current is that they are able to be decomposed by it. Now, pure water has very high resistance to the electric current, and is therefore difficult to decompose into its elements; but if a little sulphuric acid, or a metallic salt, be added to the water, the resistance is lessened and decomposition commences. In the preceding experiments, we have, if electrolysis takes place, water vapour as the electrolyte, which should, if it be looked upon as pure water, resist the current and decomposition. In order to ascertain whether water, free from acids or metallic salts, can be decomposed by the current, the following experiments were made.

(1) Illuminating gas was passed through distilled water for several hours in order to impregnate it with the constituents of the gas.

(2) A little of the water impregnated with the illuminating gas was placed in a voltmeter, the terminals of which were connected to an accumulator. The temperature of the water in the voltmeter was 65° Fahr. Both hydrogen and oxygen were evolved at once, showing that the dissolved gases obtained from the illuminating gas had lessened the resistance and allowed the current to decompose the water into its elements.

(3) Some of the vapour of carbon bisulphide would be retained by the water during the passage of the illuminating gas through it, because sulphuretted hydrogen was indicated by a test-paper at the point where the hydrogen was being evolved—*i.e.*, on the side connected with the negative pole of the battery. Water which had been allowed to stand over liquid carbon bisulphide for a few days, on being subjected to the electric current, gave off sulphuretted hydrogen in large quantity in a few minutes.

(4) Since the water vapour carried by the illuminating gas in the experiments already described, was raised to a temperature of about 158° Fahr., the following experiments were made to ascertain the effect of heating the water in the voltmeter, which was impregnated with illuminating gas. The following results were obtained on subjecting the water to the electric current:—

Temperature of Water. Fahr.	Cubic Centimetres of Gas Collected in an Hour.	
	Hydrogen.	Oxygen.
65°	0·5	0·3
158°	3·3	1·6

(5) Distilled water, acidified with a little sulphuric acid and subjected to the electric current, gave the following results:

Temperature of Water. Fahr.	Cubic Centimetres of Gas Collected in an Hour.	
	Hydrogen.	Oxygen.
65°	14·4	7·2
158°	40·8	20·2

(6) Water which had been standing over liquid carbon bisulphide, on being subjected to the electric current, gave the results shown below:

Temperature of Water. Fahr.	Effect on a Lead-Acetate Test-Paper.
65°	Dark stain in 60 minutes.
110°	" " 30 "
150°	" " 20 "
170°	" " 10 "

These experiments (1 to 6) show that with increasing temperature the resistance of the water is lessened, and is accompanied by an increasing decomposition in the same unit of time; and what is true with water as a liquid would doubtless be true with water as a vapour.

If the production of sulphuretted hydrogen in the wrought-iron pipe is brought about by electrolysis of the water vapour carried by the illuminating gas containing carbon bisulphide, it should be possible to collect the gases of the electrolytic decomposition—viz., hydrogen and oxygen. Purified, moist carbon dioxide was therefore passed very slowly (about fifty bubbles of gas a minute) through a wrought-iron pipe of 2 inches in diameter and 5 feet in length heated to a temperature of 158° Fahr.

At the outlet of the wrought-iron pipe the gas was passed into a vessel containing a weak solution of potassium hydrate, when the carbon dioxide was absorbed, leaving any unabsorbed residue for examination. It may be here mentioned that all the joints on the wrought-iron pipe were made gas-tight with gum shellac dissolved in methylated spirit. Before the wrought-iron pipe was employed for this experiment, it was tested for "activity" by passing moist illuminating gas through it while heated to a temperature of 158° Fahr.—sulphuretted hydrogen being soon produced.

The illuminating gas was then removed from the pipe by means of a current of air drawn through it for some considerable time, after which the air was removed from the pipe by passing a large quantity of carbon dioxide through it. When a sample of gas collected at the outlet of this pipe was entirely soluble in a solution of potassium hydrate, it was considered to be in a condition suitable for the electrolytic decomposition experiment already described. At the end of fifty hours, the gas collected over the solution of potassium hydrate was examined, and on analysis was found to consist of air and hydrogen; as much as 12·4 cubic centimetres of the latter gas being found in the mixture.

The hydrogen was determined by two methods: (1) By the writer's combustion over heated copper oxide method, described in the "Journal," Vol. CXVIII., No. 2554 and No. 2555. (2) By absorption in a hot solution of potassium permanganate.

In clearing the pipe of air by means of the carbon dioxide, probably a little of the former remained in the tube when the decomposition experiment was commenced—at any rate, this would account for the presence of the nitrogen. Some of the oxygen would be produced by the decomposition of the water vapour. The receiver did not contain any other gas than those mentioned above—viz., air and hydrogen. The presence of the hydrogen is proof that electrolytic decomposition of the water vapour does take place; and it is therefore correct to suggest that sulphuretted hydrogen is formed according to the equations given on page 972. On the completion of this experiment the interior of the wrought-iron pipe was examined, and it was found to be slightly rusty. This rusting of the iron was not evenly distributed, but took place in separate patches.

In conclusion, the writer can call to mind several instances, especially in the winter time, of sulphuretted hydrogen being indicated by the lead-acetate papers in gas conveyed from the outlets of oxide purifiers on gas-works, by means of wrought-iron test-pipes, while at the same time a test made at the test-cock on the purifier-cover failed to indicate the presence of this impurity. The formation of sulphuretted hydrogen in the test-pipes was caused by the heating of the gas-services by steam-pipes running near to them; the latter conveying steam to the water seals of the purifiers in order to prevent the water from freezing. If the steam and gas services should run in ground and near to each other, and the former should be faulty, the ground would be converted into a perfect hot-bed, and sulphuretted hydrogen would be formed in the gas-service in appreciable amount.

A case was brought to the writer's notice recently where an iron gas-service ran between live-steam and exhaust-steam pipes beneath an exhauster-house floor; and here, again, sulphuretted hydrogen was found, although it was known to be perfectly purified gas which entered this iron pipe. There is little doubt that oxide purifiers have been "changed" more frequently than was needful owing to the formation of this impurity in the manner described, thus adding to the cost of purification, and causing much anxiety to the manager in charge of the gas-works.

THE ADVERTISING OF GAS-COOKING, &c.

ARE OUR METHODS RIGHT?

By T. E. Pye, of Chichester.

(*Continued from p.* 579.)

As to the Advertising Literature.

If the opinions already submitted on the possible ineffectiveness of the efforts of the average lady lecturer to promote permanent extensions of the use of gas for cooking be correct, the remarks I have ventured to put forward in the issue of the "Journal" for May 28 last will apply even more strongly to the department more directly in the manager's own hands—viz., the printed literature which he may cause to be circulated among his customers.

It has recently been suggested to me by a gentleman who has specialized in the management of the gas-oven, and lectures upon the subject, that the education of the customer on gas-cooking is quite outside the sphere proper of the manager's duties. His business is to make and to sell gas, and he has no time either to know or to think anything about the cookery department. According to this, apparently, the manager must either leave such work alone altogether or he must have about him one or more specialists upon whom he must be absolutely dependent.

I cannot accept this view, though I have to confess that much is going on in certain districts I know of, and literature is being freely circulated there, that certainly tends to justify such a view more than I like. Certain it is that there is at the present time a considerable amount of literature in circulation which would never—if I mistake not—find its way out of the manager's office (except *viâ* the waste paper basket) were he to take the trouble to read it himself, or, in some instances at least, to submit it to the judgment of his wife. Few men (if any) can specialize in every

department even of their own business. But vital issues are involved in this matter; and the manager must be prepared for his undertaking to stand or fall by the printed advertising matter which, in its name, he sends out. If it be sound, reliable, and eminently practical, it can do no harm; it may do much good. If otherwise, there is no question as to the result being harmful—possibly even to disaster.

Fatal Mistakes

I have on more than one occasion been foolish enough to engage in controversy in the public Press with our friends the electricians. My experiences in this connection no doubt fully coincide with those of others in our profession who may have been similarly situated. The experience invariably is that, no sooner do we present to our opponents a really good case—by no means a difficult matter—they, realizing the futility of any attempt to honestly face or attack our position, wriggle away from the main points at issue, and proceed unblushingly to attack their opponent's veracity, his good faith in the statements he puts forward, and to impugn his motives, and generally to vilify both him and his wares. It is well known, too, that the bulk of electricity so-called "advertising" consists possibly of (say) one-third devoted to the advantages of electricity and (say) two-thirds devoted to the imaginary dangers and poisonous effects attending the use of coal gas. This class of advertising is a fatal mistake, if you have a good case. Surely the speciality which may not be advertised on its merits alone, without running down competitive wares, is not worth handling; and to attack a competitor wantonly and unprovoked is surely the strongest evidence of a very poor case. This, if I mistake not, is the view of the great British public to whom it is our business constantly to appeal.

From which We are not Altogether Free

I greatly regret to see that this class of advertising is in vogue in certain of the gas literature to which I have referred. I saw in a show window only yesterday one of the very books I am now about to consider, and which in its very first page contains paragraphs which cannot fail in certain directions to turn possible customers entirely away from gas for cooking—chiefly on the ground that, in the opinion of the reader, the writer either knows nothing of his business or he is—well—a prevaricator.

As Here Exemplified.

I have now before me four books, written ostensibly for the guidance of the user of the gas-cooker, of comparatively recent publication. They each, with one exception, bear the name of one well-known gas undertaking or other, and have evidently been prepared and published for circulation (gratuitous or otherwise) among the customers of the various gas undertakings of the country. I venture to think that, on the whole, the three last-named books are calculated in the end to do more harm than good. And for the simple reason that much of the information given is misleading and likely to land the reader in trouble and loss—thus to cause intense irritation, and to bring the gas and the undertaking, and especially its management, into discredit, and possibly under ridicule also.

As just intimated, I find two opening paragraphs of one of these books to which I take the gravest exception. They cast reflections upon the old style of cooking in a closed coal oven which cannot fail to arouse the ridicule of many a good housewife, who, maybe, through long years of a consciously useful life, has known no other means of cooking, or (not less likely) of the daughter of such an one, who knows how her mother and friends have managed so well in the past, and promptly decides that the writer of such "rubbish" (her description, not mine) evidently was a man, and knew nothing of what he was writing.

Closely following are two paragraphs calling respectively for special attention and service to the cooker, and for the use of a certain special appliance, as to which—in my experience—I have never known any customers on their own initiative to fulfil either condition. As to one of these, I should never ask for it; the other need only be recommended in certain very exceptional cases. To suggest such unnecessary precautions and work, at the very outset, is to say the least distinctly foolish. It must undoubtedly deter rather than attract prospective customers. My chief hope is that they do not read such matter.

The instructions on oven management include several very debatable points, and a condemnation of one provision at least which we have—after a 25 years' experience—always found distinctly helpful, and which is still strongly recommended by many experts. The policy of introducing debatable matter in a work meant for popular use such as are these books, is certainly in bad judgment. To write dogmatically upon them is worse. If mentioned, they should surely be suggested in an alternative way. As these paragraphs stand, they will in some cases at least cause confusion, and be in direct contrast with the "Instruction Card" of the stove manufacturers.

The time allowances are also open to question. This may possibly be considered by some as inevitable. But personally I do not see why. Plenty of time, with a slow consumption of gas, for the ordinary—general cooking (say, except pastries), is distinctly preferable to haste and risk of scorching, or surface cooking only (not an unusual failing at many of our cookery lectures).

The instructions for pastry and cake baking are such as will tend to turn away many a customer from the gas-cooker altogether; and the very close but intermittent attention called for for certain classes of ordinary cake-baking is absolutely prohibitive—suited admirably for the demonstrator, close by the cooker all the afternoon, but impossible for the busy housewife, and largely unnecessary.

Cooking on the hot plate, both by grilling and boiling is dealt with; but here again there are several items which—to say the least—are open to question, and will be hotly disputed by many practical every-day users of the cooker.

I had proposed to deal in this article with all four books before me. As, however, the foregoing criticisms equally apply to two other of the three referred to, I need not occupy space further with this phase of the subject. But, casually looking into the pages of the remaining volume, not of such recent publication, and the contents of which were wholly unknown to me, I was agreeably surprised to find in the information which it conveys to its readers (evidently presumed to be gas consumers, either actual or prospective) indirect, yet full, confirmation of the views I have ventured to submit, and every justification of my criticisms. One of the works is published by a firm which has for many years had the closest associations with the gas industry—a circumstance which probably accounts for the eminently practical nature of the recommendations embodied throughout its pages. And it is one, doubtless among others, of the guides to the use of gas-cookers which the manager will not, after careful perusal, hesitate to put before new or old customers.

The lesson is obvious—very practically illustrated. There is no difficulty in presenting to our customers literature, educational in character, and self-evident in its propositions, and which, by the confidence it inspires in the undertaking it represents, will promote to no mean extent the best interests of the concern.

We have been too lax in this matter, and whether the advertisement put forward be in the form of printed literature, lecture, or of practical demonstration, it behoves the manager himself to subject it to the most practical tests before he submits it for the guidance and assistance of his customers.

DIRECT RECOVERY OF AMMONIA AS SULPHATE.

By Arthur Douglas, B.Sc.

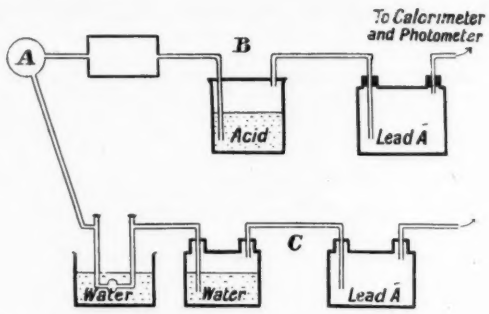
[Second Article.]

In a recent article (*ante*, p. 156), the writer dealt with the question of the adoption of a process for the direct recovery of ammonia on gas-works, and then indicated a few of the principal points in which gas-works practice differed slightly from coke-oven practice. It was suggested that, by the recovery of ammonia in this way, the purification from sulphuretted hydrogen and carbon dioxide would be rendered heavier, owing to the fact that no ammoniacal liquor is produced, and hence the value of ammonia as a purifying agent would be lost. The additional sulphuretted hydrogen and carbon dioxide would thus pass forward with the gas—to be dealt with by means of oxide and lime purification.

At first glance, it seems as if this would involve some increase in purifying area and, consequently, in cost. This argument has often been put to the writer by gas engineers. It is all the more interesting, therefore, to note in this connection a statement by Mr. Philip G. Moon, in a paper before the Southern District Association of Gas Engineers on Nov. 10, 1910. He says: "If the best possible use by ordinary scrubbing methods is made of the ammonia, about 200 to 300 grains of carbonic acid and 100 to 120 grains of sulphuretted hydrogen per 100 cubic feet are removed. If the carbonic acid went forward, the volume of the gas would increase by about 0·5 per cent., and reduce the illuminating power by about 0·3 candle. The sulphuretted hydrogen would be absorbed by the same purifiers without trouble." From this point of view, therefore, not much difficulty need be anticipated; for, at the most, the only extra work involved is that of changing the purifiers a little more often.

With regard to the effect of the sulphuric acid in the saturator on the illuminating power and the calorific value of the gas, the experiments previously described have been repeated, and others have been made in addition, details of some of which are herewith appended. The first series of experiments, although done on a laboratory scale, were made to agree with actual conditions existing on works so far as temperature, pressure, and strength of solution were concerned. The crude gas was taken direct from the hydraulic main and led through a tar-filter, where practically all the tar was removed; the gas leaving this apparatus at a temperature of about 100° C. The usual temperature in the saturator in the direct process is about 50° to 70° C., and the solution contains anything from 4 to 20 per cent. of free sulphuric acid. If the temperature falls much below 50° C., condensation of the aqueous vapour takes place, the solution is weakened, and crystals of ammonium sulphate are not deposited. It is necessary, therefore, to test the strength of the acid solution from time to time, so as to keep it in a condition suitable for the production of crystals. In the present case, it was maintained at about 10 per cent. free acid, and the temperature was maintained at about 60° C.

The arrangement of the apparatus is shown in the diagram. The crude gas led from A could be diverted through either set of apparatus B or C. B works on the direct process, and C on the old process, of cooling and scrubbing. In each case the sulphuretted hydrogen was eliminated from the gas before testing either the calorific value or the illuminating power. It might be mentioned also that, in addition to these, the ordinary gas supply



was tested simultaneously for the purposes of comparison. Gas was passed through both sections of the apparatus at approximately the same rate until each had passed 10 cubic feet. The contents of the saturator B were then removed and distilled with lime; the ammonia evolved being absorbed in standard acid, and hence the amount of ammonia retained in the saturator was calculated. This was found to be equivalent to 2·8 lbs. of sulphate of ammonia per 1000 cubic feet of gas, while in actual practice only 2·6 lbs. was obtained. This phase of the question, however, is dealt with more fully at a later stage.

Gas was again passed through both sets of apparatus, and the calorific value and illuminating power of each tested at varying intervals. The results obtained are shown in the table. For the sake of completeness, the corresponding figures for the ordinary town supply are also given.

		Direct Process.	Old Process.	Town Gas.
1	Illuminating power	14·7	15·2	15·2
	Calorific value	135 calories	138 calories	137 calories
2	Illuminating power	14·9	15·1	15·2
	Calorific value	138 calories	140 calories	140 calories
3	Illuminating power	14·7	15·1	15·2
	Calorific value	130 calories	135 calories	137 calories

It will be seen from the table that there is very little difference indeed between the values obtained from the gas whether treated by the direct process or by the old process; and this is borne out by observation and experiment with gas made on coke-works where the ammonia is extracted by the direct process. The illuminating power is a fraction of a candle less in each case; but for all practical purposes this is negligible. It was stated in the previous article that no action was observed on the gas until the acid bath contained about 50 per cent. of free acid—a strength which would never be reached in the direct process. So far as the writer is aware, the exact strength of acid and the temperature at which definite absorption of constituents of coal gas does take place, has not yet been satisfactorily determined.

Considering this question further, if absorption does take place, it will be of the constituents of the benzene and acetylene series. In order to ascertain this, a number of analyses of gas were made, without, however, taking account of the influence of the temperature of the acid bath. A large sample of gas was taken, and tests made with different portions in a Hempel pipette, using varying strengths of acid. The composition of the original gas was as follows:

	Per Cent.			Per Cent.
O	0·9	..	CH_4	31·8
C_6H_6, &c.,	3·6	..	H	48·0
CO	8·2	..	N	7·5

The following table shows the absorption with various strengths of acid. At about 30 per cent. of free acid, practically no absorption was noticed.

Percentage of Free Acid.	Absorption.	Temperature.
100	3·6	16° C.
90	3·4	..
80	2·8	..
70	2·0	..
60	1·1	..
50	·5	..
40	·2	..
30	..	..

In the Editorial Note on the previous article on this subject, it was remarked that: "What is wanted is working proof of the advantage of the direct in comparison with the old separate system." So far as working proof is concerned, one can only point to the unqualified success which the direct process has met with on coke-oven installations. No gas-works—at least, to the writer's knowledge—is yet so equipped. So far as costs are concerned, however, comparison can be made with reference to coke-oven installations. At very few coke-works indeed is the old system still in operation, as it can be shown conclusively that, in working expenses alone, for a battery of fifty ovens a saving of at least £1000 can be made. The yield of sulphate in the direct process is greater than that obtained by the old process, as there is less chance of loss by evaporation, &c.

The writer has spoken to many gas engineers on this question; and the general opinion is that it will come—in time. The process itself has got out of the experimental stage years ago, and what is now wanted is some gas corporation bold enough to put down a trial installation on a gas-works. The cost is not prohibitive; and in the unlikely event of its proving unsuccessful, it would not be a difficult or expensive matter to convert-back to the old system.

THE VALUE OF GOOD ILLUMINATION

AS REGARDS HEALTH AND AS A MEANS OF PREVENTING ACCIDENTS.

At the Congrès Technique International de Prévention des Accidents du Travail et d'Hygiène Industrielle, held in Milan last month, a communication was presented by Mr. L. Gaster, Editor of the "Illuminating Engineer" (London), and delegate of the Illuminating Engineering Society of London, on the "Value of Good Illumination as Regards Health and as a Means of Preventing Accidents."

In the opening portion of his paper, Mr. Gaster pointed out that with the illuminants themselves he did not propose to deal; his intention being rather to refer to their applications from the standpoint of those responsible for the health and safety of workers. Many matters in connection with industrial hygiene—such as ventilation, good water supply, &c.—now received close attention; and he said he believed good illumination would soon be regarded as demanding equally careful supervision. A natural result of the development in artificial illumination was a vast increase in the amount of work carried out when darkness had fallen. Business was now done by artificial light as a matter of course; and good illumination was therefore coming to be regarded as an absolute necessity, in the same sense as adequate ventilation, water supply, and proper sanitation. The first necessity in lighting, whether natural or artificial, was that there should be sufficient illumination for the work. There were already many instances in which it was clearly stated that the illumination of particular premises must be "adequate" for the purpose in view. But it was now desirable to consider the possibility of making such recommendations more definite. "Adequate illumination" should be defined more precisely; and, in order to do this, the necessary data and statistics must be accumulated. He therefore urged upon the Congress the importance of at once making preparations for the desired data to be collected in future. In addition to the provision of sufficient light, however, it was equally essential that it should be wisely used. Besides the ill-health traceable to bad lighting, there was another perhaps equally important matter to consider—the value of good illumination from the point of view of safety. A number of mishaps arose through defective lighting. After illustrating the kinds of accidents that might be anticipated from this cause, Mr. Gaster continued:

Having thus briefly surveyed the question of the value of good lighting in factories, especially as a safeguard against accidents, I should like to conclude by a brief review of the recent important steps that have been taken to improve matters in this respect, and to gain fuller information. During the last few years, there have been quite a number of valuable conferences on the subject. I have already alluded to the interest taken in illumination by the Home Office in Great Britain, as exemplified in recent reports of H.M. Chief Inspector of Factories and the emphasis laid on good lighting by the recent Departmental Committee on Accidents in Works.

A great step has also been taken in the appointment by the French Government of a Committee on the Hygienic Aspects of Illumination, on which prominent physiologists and oculists, engineers and physicists, and inspectors of factories are represented. The main objects of the Committee are stated to be as follows:—

1.—To study, from the standpoint of general health, and its effects upon vision, the various methods of artificial lighting now in use.
2.—To determine the composition and quality from a hygienic standpoint of the different combustible illuminants, and to examine the effect of prejudicial gases and the amount of heat developed thereby.
3.—To fix a certain minimum amount of artificial illumination favourable to normal requirements of vision.
4.—To study the most practical methods of measuring illumination.
5.—To formulate recommendations governing the best means of applying customary methods of lighting to the chief varieties of industrial operations.
6.—To present to the Ministry a report on the subject of short sight and impairments of vision and on the best methods of guarding against the causes of myopia.

It appears to me to be extremely desirable that this enterprising step on the part of the French Government should be followed in other countries. I have already made representation to this effect; and I trust that the time is not far distant when similar committees will be instituted elsewhere. In such a matter as this, international co-operation would be of immense assistance. In order to arrive at conclusions which will be accepted generally throughout the entire civilized world, it is essential at each step to

have corroborative evidence by various authorities and to make sure that the needs of different countries are borne in mind. It is also important to have at one's disposal results of researches made in a number of different trades independently, so as to avoid being possibly misled by generalization from tests of a few individuals.

I must also not forget to acknowledge the valuable pioneering work in stimulating public interest in illumination which has been carried out by the Illuminating Engineering Society in the United States during the past few years. A new body—the National Association for the Conservation of Vision—has also now come into existence in that country, and will doubtless supplement the work done by the Illuminating Engineering Society in an effectual manner.

In England, there are several Societies which have devoted much attention to industrial hygiene; but I would like to single out for special mention the Royal Society of Arts, which, for more than 150 years, has made a constant practice of encouraging investigation on problems of the day. It has also been instrumental in offering prizes for safety appliances, lamps, &c., and as each new method of illumination made its appearance was prepared to consider its practical applications in an impartial manner. The Illuminating Engineering Society in London, although only formed in 1909, has also been signally successful in this direction; and I am glad to say that it includes among its members many of the greatest Continental authorities on various aspects of illumination, and is therefore in an exceptional position to promote international co-operation in these matters.

This leads me to mention one concluding step which should prove of the very greatest importance in raising the status of illumination in the future—namely, the resolution passed at the International Electrical Congress at Turin last year sanctioning the formation, by the Illuminating Engineering Society of London, of an International Commission on Illumination. This Commission, it should be explained, is to be competent to cover the whole field of illumination. It will deal with such questions as photometry, nomenclature symbols, the rating of illuminants, &c.; but it will also have power to study more practical questions, such as the amount of illumination required in various industrial employments, and the hygienic effects of various illuminants. In dealing with these, it will naturally avail itself of the conclusions reached by the Expert Committees on the Hygienic Aspects of Lighting suggested above, and should have great weight in ensuring their being carried into effect in practice.

This International Commission on Illumination will also be recruited from local committees in each country, many of the members of which might naturally also be members of the National Committees on the Hygienic Aspects of Lighting. In this way all these various agencies could work hand in hand for the improvement of illumination and assist each other. It might also be suggested that, in allotting the work, each country might be charged with a certain section in which it was specially interested and was particularly fitted to perform; that the results, corrected, should be sent periodically to the various Committees and discussed at international conferences.

What, therefore, are the steps which may be suggested as a means of improving industrial lighting, and which are the parties likely to benefit by them? One step I have already indicated—namely, the formation of Government Committees on the Hygienic Aspects of Lighting in the chief countries of the world and their co-operation with a view to securing corroborative evidence where necessary, but avoiding unnecessary duplication of work.

The next point to be observed is that, before any definite regulations can be made, the careful collection of data through suitable channels is necessary. Sig. F. Massarelli, in his paper before the Brussels Congress, brought out this point very clearly. He explained that, although much has been written on the subject by physiologists and lighting engineers, there are very few generally accepted practical rules by which inspectors and the representatives of insurance companies, &c., can be guided. On many points conflicting and biassed statements are constantly being made, and we have as yet no properly organized machinery for getting at the truth.

There are, however, several channels through which much valuable information could readily be obtained. For example, factory inspectors, as a preliminary to agreement on definite rules, might be instructed by the Governments in their respective countries to take particulars of the lighting conditions in the factories visited, as well as the condition of health of the workers, in order that we may be able to trace what connection exists between these two elements. For example, in the case of trades known to be trying to the eyes, particulars of the illumination, and also of the eyesight of the operators, might be noted.

It is possible that occasionally the testing of the eyesight of workers might present some difficulties, in view of the fact that it is not at present prescribed by law, or that employees are reluctant to submit to test, fearing dismissal if their defects of vision become known. In such cases I would venture to suggest that inspectors should be provided with a letter from the Government authorizing them to make such investigations, and explaining that they are carried out for statistical purposes, and that the results will not be used to the detriment of employer or employee.

In reporting on the illumination, inspectors should take note of obvious defects, such as the misplacing of lamps, the use of imperfectly shaded illuminants liable to be prejudicial to vision, and the neglect of adequate lighting for dangerous machinery, &c. But, in addition, I strongly recommend that actual measurements of illumination should be made, as precise data of this kind form a most valuable supplement to personal impressions for future reference. Although not yet perfect, instruments for the measurement of illumination have been very much improved; and the Home Office in Great Britain, I am pleased to say, have already accumulated a considerable amount of data of this description in various factories.

It may also be suggested that a similar record should be kept as regards accidents. This matter is of considerable importance to insurance companies, friendly societies, and labour associations which are concerned with compensation cases. One of the witnesses before the Departmental Committee on Accidents, Mr. J. W. Frist, a member of the Friendly Society of Iron Founders, stated that there had of late been an increase in the number of accidents, and intimated that a considerable proportion of them arose through defective lighting. It appeared, however, that there were not available records of the percentage of accidents due to this cause. It may be suggested therefore that, when an inquiry is made into the circumstance in which an accident occurred, particulars should be taken of the general lighting conditions at the time, and, if possible, also actual measurements of the illumination made.

It will be seen that in attacking this problem co-operation is most essential. It would, for example, be to the benefit of many companies to arrange for the services of an expert in measuring illumination as well as a physiologist to work together in tests of this kind; and the committees appointed to investigate the matter would require to be fully representative in character. It would naturally be the function of the committee in each country to make use of all existing channels of information, and collect the results together, as well as organizing special researches.

In conclusion, it may be pointed out that an improvement in the conditions of lighting in factories would be an all-round benefit. To insurance companies it would be advantageous, because it would diminish the risk of accidents, both personal and through fire and mishaps to machinery. I venture to suggest that it would pay such companies to allow specially favourable rates to businesses in cases in which the illumination was up to a prescribed standard (just as is already done when the precautions against fire are exceptionally complete). The employees would indisputably benefit, seeing that they would work under pleasanter conditions and with less risk; and the employer would benefit in several ways.

The cost of improving the lighting would certainly not be grudged if once it were shown beyond doubt that improved illumination led to fewer accidents. At a recent meeting of the Illuminating Engineering Society in the United States, Mr. C. W. Price mentioned a company in the case of which 43 per cent. of the employees either suffered injury or lost time through ill-health during the year. By 1909, however, this percentage had been reduced to 10 per cent.—a result which was ascribed largely to improved illumination.

The enlightened employer also recognizes that it is to his interest commercially to secure adequate illumination because of the improved output and quality of the work. Mr. Roscoe Scott* has recently pointed out that in very few businesses does the cost of lighting amount to more than 5 per cent. of the wages bill (in the case of an incandescent lamp factory mentioned, it was less than 1 per cent.), so that any small expense involved in putting the lighting on a proper basis would be very readily repaid by the improved work and freedom from accidents and mishaps secured as a result. An interesting illustration of this fact is afforded by the cotton industry. It appears that "summer-made" goods, in certain classes, are invariably listed at a higher price than those made during the winter—the explanation offered being that owing to the inferior artificial light in winter the quality of workmanship is not so good.

There is every reason to contend, therefore, that good illumination is a benefit from which all derive some advantage and that adequate lighting is both essential to the health and one of the greatest safeguards against accidents. In this paper, I have only suggested a few of the many possible illustrations of this connection; and I hope that before long we shall have available data by which it can be still more clearly established.

* "Electrical World," Feb. 10, 1912.

The Congress of the Universities of the Empire, which is to be opened in London on July 2, will naturally deal with subjects in which "JOURNAL" readers are not exclusively interested. Among other contributions to the Congress, however, we notice that on Wednesday, the 3rd prox., Professor Arthur Smithells, of Leeds, in conjunction with Mr. Stanley Leathes, will contribute a paper on "The Relation of Universities to Technical and Professional Education and to Education for the Public Services."

In the lists supplied by the City and Guilds of London Institute from which the names of the successful candidates in the examination in "Gas Supply" were reproduced in last week's issue of the "JOURNAL" (p. 890), the name of Mr. Edward J. "Ruff" appeared as having passed in the Final Grade, First Class. We have since learned that this should have been Mr. Edward J. Luft (the son of the Secretary of the Oriental Gas Company), and who was also successful in passing the examination in "Gas Engineering," Final Grade, First Class.

FRENCH COMMISSIONS' REPORTS.

[Presented at the Annual Meeting of the Société Technique du Gaz.]

Last year, in the "JOURNAL" for Sept. 19, we referred to the first reports of the Technical Commissions which had been established by the Société Technique de l'Industrie du Gaz en France, pointing out that, of necessity, they were, at that time, largely of a preliminary character. In the programme of this year's annual meeting of the Society, held last week in Paris, there appear the reports of the five Commissions which have been constituted, dealing respectively with coal analysis, manufacture, distribution, application, and instruction. The following are translations (in full or in abstract) of the reports.

COAL ANALYSIS.

During the past year, the Commission on Coal Analysis has examined a certain number of questions.* Those which appear to be the more important are set out in the following notes. They are connected together only in so far as they relate to the very important subject of the investigation of the industrial value of coal from the special point of view of the gas industry.

NOTE I.

General Considerations on the Quality of Coal and the Products of Distillation Capable of Measurement.

Scientifically Defined Characteristics, apart from Special Agreement.—Among the qualities of coal and the products of its distillation, some (and these the largest number) are strictly and scientifically defined, apart from the methods which are used for their measurement whatever may be the expression of their definition. This is the case with the composition and calorific power of coal and gas, and the specific gravity of the gas, &c. There is nothing conventional in these definitions. Qualities of this kind can be measured more or less accurately by methods more or less simple, and of more or less expensive application. The professional chemist will always hold himself free to choose his own method, according to the accuracy he desires and the pecuniary resources at his disposal. For these kinds of qualities, there would be no question of regulation and compulsory method and equipment, except in the case of a manufacturer under contract to supply to a consumer goods having a certain fixed degree of one of these qualities. Thus, for example, a gas company binds itself to deliver to a municipality gas of a minimum heating power of n calories. It is agreed that there should be control of the quality of the gas; and the contracting parties, in order to avoid any dispute as to the correctness of tests, stipulate that these shall be carried out by a precise, detailed method. In fact, this amounts to replacing the scientific definition of heating power by a conventional definition. The parties implicitly admit that the calorific power of the gas sent out is not the amount of heat produced by the combustion of a cubic metre, but the figure at which one arrives at the end of a certain series of operations described in the contract.

Qualities and Conventional Definitions.—Coal, gas, &c., have not only the qualities of the kind just referred to. They also have others of great interest from the practical point of view which do not exist outside their conventional definition; and it results that there are several concurrent definitions, so that the same word does not mean the same thing for everybody. In the front rank of these qualities, is the lighting power of the gas—the sole admitted test of its selling value throughout long years. Lighting power of gas does not exist by itself. It is necessary to define it, in some sense to create it before measuring it. Many definitions, very dissimilar, have in fact been proposed and accepted in different parts of the civilized world. This divergence has been rather prejudicial to the progress of our industry. It is regrettable that in the middle of last century an international gas congress did not reduce to uniformity the exact meaning of the words "lighting power of gas" into a kind of formula, such as:

> "It is agreed that everywhere in the future 'Lighting Power of Gas' shall mean the number of hours employed to consume a cubic metre of this gas under well-defined conditions and in a typical burner, the illuminating intensity of the flame remaining constant, and equal to an invariably fixed number of units of a given illuminating standard."

Such a definition as this would have still left very great latitude to experimenters in the choice of the photometer, the standard adopted, and the arrangement of the apparatus, &c. But it must be recognized that the unification of the lighting power cannot be undertaken in our time—firstly, because this quality of the gas has lost much of its practical interest; and next, because the beaten tracks have become too fixed and tied to too many binding contracts to leave any hope of changing them.

This distinction being established between the different qualities of coal and the products of its distillation, the Commission on Coal Analysis proposed through the year to consider chiefly the qualities of which the definition is more or less conventional; and, among other things, the object of these investigations was:

1.—To make this definition uniform and precise, if that be necessary.

2.—To describe in detail the part of the apparatus, and the aspects of the material operation, which, to some extent, form an essential part of the conventional definition adopted.

As far as the investigation into coal is more particularly concerned, the operations considered are the following:—

1.—The determination of the physical composition of a consignment of coal—that is, the respective proportions of large, medium, small, &c, comprised in the consignment.

2.—The determination of the volatile fraction and the amount in ash by calcination in a closed crucible.

Physical Composition or Classification.—It is generally admitted, and nearly always rightly, that, other things being equal, a delivery of unscreened [*tout-venant*] coal is the better for containing a greater amount of large pieces and less of small. It would be a good thing if a definite figure could be arrived at, as far as possible, to be used as a conventional standard in this respect for unscreened coal.

Formerly, in the Compagnie Parisienne du Gaz, the coal was classified into four sizes by means of three sieves having spaces between their bars of 100, 40, and 10 mm. respectively. But in practice, attention was only paid to the last figure, showing the percentage of small and dust. Some time ago, the sieves of 100 mm. and 40 mm. were discarded. The practical advantages of this method of classification are set out in a special paragraph later on. The Commission has accepted this view, and proposes to adopt the term "small" [*fines*] for what passes the 10 mm. sieve, and "medium" [*gaillette*] for what is rejected by it. The value of unscreened coal in relation to its size will be measured by the proportion per cent. of medium. A sieve made up of bars of round iron, 10 mm. in diameter separated 10 mm. from one another, inclined at x^2, is all that is required.

Calcination in Crucible—Volatile Matter—Coke.—Coal is not a mixture of a fixed composition and of a volatile part in ascertained proportions. If a certain weight of coal is placed in a closed crucible and gradually heated to bright red to the point where all gaseous products are given off, the loss of weight in percentage of coal, moisture deducted—that is, the proportion of volatile matter—will vary within certain limits according to the weight of coal used, the heating, and the final temperature, &c. The maximum differences will not be very much and will not exceed 2 per cent. That is to say, two tests carried out in a different way will give, for example, 30 per cent. and 32 per cent. of volatile matter respectively. The volatile fraction must be considered, not as an absolute amount, but as a yield depending upon the way the distillation is carried out. Now, thanks to the works published by specialists, we know how to conduct the operation so as to secure the maximum yield. The method known as "American," advocated by Professor Constam, the Director of the Federal Laboratory for Tests and Fuels at Zurich, is the most authoritative among those giving this yield. The traditional process followed for years at the experimental works of the Compagnie Parisienne and afterwards by the Société du Gaz of Paris, and described later on, also gives this yield. No doubt there are others, all differing but slightly. Under these conditions, the Commission proposes to decide that, in future, the qualification of amount in volatile matter will be reserved only for the maximum yield in gas, leaving to those interested freedom of choice among the methods capable of giving this yield, according to the conditions under which they work and the ability of the staff under them. But it is to be noted that, in coming to such a decision, the Commission places itself entirely at the point of view of gas manufacturers and their contractors. Manufacturers of metallurgical coke seek first, not the yield of volatile matter, but its complement, yield in coke. For them, therefore, it is the maximum yield in coke which would have the right to be called amount in coke. Consequently for them the best way of conducting the calcination would be that which reduces to its minimum the loss by volatilization. So that the maximum "amount" in coke is not the complement of the equally maximum "amount" in volatile matter. The Commission draws attention to the confusion that may arise from this circumstance.

NOTE II.

Classing and Sampling Coal.

I.—IN IMPORTANT WORKS.

Among the different methods of effecting these two objects in a large works, the Commission describes those in use by the Société du Gaz of Paris. At the experimental works of La Villette, all the coal to be tested is classed into two categories—small and medium. The choice of the 10 mm. sieve arises (1) from the fact that with it, for unscreened coal, the respective quantities of the two categories are always about the same. Rarely is the proportion of medium in excess of 60 per cent. or less than 40 per cent. (2) From the fact that there is nearly always a very marked difference between the amount in ash of the small and in that of the medium. In short, this sieve seems to separate most plainly the good coal from the bad. During more than two years (Jan., 1900, to May, 1902), the classing with this sieve was done on every 5 tons of the coal tested in the retorts. The medium and fine were then brought separately to a crushing shed, and entirely reduced to powder by a Carr apparatus. Care was, of course, exercised methodically to take samples of the powder which flowed in a continuous stream from the crusher. This expensive process offers greater security in the exactness of a sample. The drying

* See "JOURNAL," Vol. CXV., p. 733.

and analysis of the samples were done separately; and the composition of the unscreened bulk was deduced from them by a simple calculation of proportion.

During this period, 211 tests were made relating to 60 different sources of unscreened coal, and they show how the amount of small varied. The highest figure for an average of tests on the same coal is 60·15 per cent.; the lowest, 17·30 per cent. Some coals showed a constantly higher amount in medium.

As regards the respective quality of medium and small, it was observed that, save for six coals which were exceptions in this respect, the small was always less rich in volatile matter and more ashy than the medium. The average figures are:

(1) For the six exceptional coals, coming nearly all from Durham:

	Medium.		Small.
Volatile matter	29·75	..	29·68
Ash	10·16	..	9·25
Volatile matter (ash deducted)	33·12	..	32·71

(2) For all the other coals tested [Pas-de-Calais, Durham, Yorkshire, Scotch, Ruhr, Saar]:

	Medium.		Small.
Volatile matter	33·80	..	31·73
Ash	8·38	..	12·64
Volatile matter (ash deducted)	36·89	..	36·32

In addition, without any exception, the small is always more moist than the medium. This will surprise no one.

In the alterations at the experimental works which the Société du Gaz are studying, there is provided a mechanical treatment for testing coals which will greatly improve the present methods for this purpose. Pending this, the operation includes, first, the classing of 2000 kilos. taken from the heap of 40,000 kilos. intended for an industrial test. The medium is reduced by hammering to a size near to that of the small. An instalment of about 25 kilos. is taken from each of the two heaps, and broken smaller in a flat-bottomed mortar. Two fresh samples of 500 grammes are taken, which are tested by drying in a thin layer on an iron plate in a stove kept for two hours between 95° and 100° C. The dry product is then finely powdered in a crusher like a coffee mill, and next a sample of 100 grammes is put in a labelled bottle for the actual analysis. The composition of the unscreened coal is the result of the proportional average of the small and the medium.

To sum up, the average composition of a considerable delivery of unscreened coal depends essentially on the proportion existing between the weight of medium and small. The medium is generally spread in a very unequal way over the waggons and the boats; and one of the greatest difficulties of sampling is to make at the start a sample in which the proportion of medium and small is correct. It is obvious that the more correct this first sampling is the more exact will be the classing by the sieve. Once the classing is done, the best thing is to reduce the whole of each of the two categories into powder by a mechanical process. After they have been analyzed separately, the results can be tabulated in the following form:—

—	Proportion.	Moisture.	Percentage of Dry Coal.		
			Volatile Matter.	Ash.	Volatile Matter (Ash Deducted).
Medium	54·1	1·42	34·31	8·71	37·58
Small	45·9	3·50	32·52	11·84	36·89
Unscreened	100·0	2·37	33·49	10·15	37·28

Coal Classed on the Pit Platform.—It is often the case that the coal delivered by a colliery is not unscreened, but is already classed and sold under varying descriptions, such as screened, washed or unwashed nuts, &c. It is obvious that in such a case, the bulk being more homogeneous, the initial sampling will be of less importance. The classing by the sieve will no longer have the same value as for unscreened coal. It will only be done when the appearance of the bulk shows that the preliminary screening at the pit has not been suitably carried out.

The foregoing suggestions apply to cases where the average quality of an important delivery has to be ascertained. If the coal to be analyzed is sent to the laboratory in a box or sack merely containing some kilogrammes of it, the chemist has no more concern with the test selection made, which has been done apart altogether from him. He has only to take a sample. Classing has nothing more to do with it. It is necessary, in this case, to reduce the whole of the consignment to a fine and homogeneous powder.

Where a gas company enters into a contract of supply with a colliery company, with a guarantee of a minimum of volatile matter and a maximum amount of ash, the test selection and sampling should always be done in common up to the point of obtaining a fine powder. This can be put into three bottles of at least 100 grammes—one bottle being sealed. In this way, disputes can only arise as to the laboratory operations of calcination and incineration. They will never be serious, and will always be easy of settlement. It would not be the same if each of the parties was free to make the test selection and take the sample without the control of the other. Disputes would then be as frequent as they would be difficult of solution.

II.—In Average and Small Works.

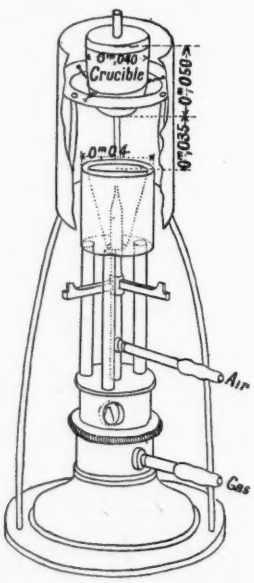
The selection here is a very important task, and ought to be done with great care, if the results of the analysis are to conform to actuality. Except in particular circumstances, it is advisable to proceed to the sampling at the time when the coal arrives at the works and before it is put on the heap. If the coal is brought to the works in carts, four shovelfuls should be taken from each cart and put in a box provided with a cover. Each cart being supposed to hold 2000 kilos., we should have for a 10,000-kilo. waggon, a sample weighing about 100 kilos. If the railway waggons enter the works, about the same quantity could be taken at the time of their being emptied; care being exercised to select from the whole bulk. From a boat, the same method of taking shovelfuls should be adopted. Care should always be taken to get a sample sufficient to represent about 1 per cent. of the delivery, or 2000 kilos. for a boat of 200 tons. In case the unloading takes several days, it is very advisable to use a small iron truck, or a cylindrical receptacle on wheels, provided with a closely fitting lid with a rubber joint, and having a padlock. Such a receptacle (containing 150 to 200 kilos.) in duplicate, would allow, after breaking the pieces to the size of a nut, of quickly dividing it into half (as hereafter described) so as to have in the second receptacle 12·5 kilos. taken from the 200 kilos. in the first. A boat of 200 tons, discharged in two days, will give ten primary receptacles, or 2000 kilos., from which the second receptacle will receive 125 kilos. When coal is loaded into waggons or boats by shoots, it separates—the large pieces going to the bottom; and it is necessary that the shovelfuls be taken at all the heights and at all the different points possible.

Where a waggon has had the rain on it, the top surface is more soaked than the rest, and this should not be drawn on, but rather the whole bulk. The same reason, acting inversely, applies to a very dry layer of a waggon loaded when wet and travelling under a warm sun. The initial sample ought to represent as faithfully as possible the whole bulk, as to the proportion of large, fine, moisture, &c. This initial sample, weighing about 100 kilos., should be spread on a cemented flat area in the shade. The pieces should be broken so as to pass through a sieve of square mesh with 20 mm. openings. The coal will then be well mixed, and next spread in a square of about 1·50 metres and of uniform thickness. This square is divided diagonally into two. One of the triangles is discarded. The other is mixed, re-made into a square, and again divided diagonally. And so on until a sample weighing from 3 to 4 kilos. is obtained. This is put into a tin box, the cover at once soldered, and the box sent to the laboratory making the test. If it is desired to have a test for ash or moisture, a second triangle of 3 to 4 kilos. can be put on one side. All these operations ought to be done very rapidly, so that the coal loses the least moisture. By proceeding as described, an average sample sufficiently representing the total bulk of the consignment will be obtained.

NOTE III.

Calcination and Incineration.

The methods described are those adopted by the gas undertaking of Paris. The sample of coal to be analyzed is supposed to have undergone the operations described in Note II., and to be in the form of a dry and fine powder enclosed in a labelled bottle. The object now is to ascertain the maximum yield or amount of volatile matter and the weight of ash.



Berzélius Burner for Calcination.

Weighing.—The scales used need not be of very great precision. It is enough if they weigh correctly to a milligramme. Once for all (except, of course, for frequent verification), the tare of a watch glass placed on the right-hand tray is taken with a weight of

2·5 grammes. The contents of the bottle are turned out on to a flat plate and four lots of 2·5 grammes each are successively weighed—care being used to take them in little spoonsful from all parts of the plate. As soon as weighed, each lot of 2·5 grammes is turned into a platinum crucible as shown at the top of the accompanying illustration. (The weight of the crucible is about 36 grammes; the weight of the cover, about 10 grammes). The four crucibles, which contain the 10 grammes of coal in all, are placed in a metal box and taken from the weighing room to the calcining laboratory.

Calcination.—The calcination is effected by a burner known as the "Berzélius Burner for Calcination," shown in the illustration. It includes two operations: (1) The burner works as a simple bunsen (without air-blast). The flame, kept at the limit of blue and white, completely envelopes the crucible. The coal begins to be distilled, and a jet of white flame comes from the central chimney. (2) As soon as this flame begins to be sensibly lessened, an attack by flame is made—that is, a jet from the blowpipe is directed at the bottom of the crucible by means of a foot-bellows, or from an air-tank at 350 to 400 millimetres pressure. The bottom and the whole crucible being brought to bright red, the blow is continued until the hydrogen flame visible at the top of chimney has entirely disappeared. It is then put out, and the crucible returned to its box, where it rapidly cools. The whole operation lasts about five minutes for each crucible, or 20 to 25 minutes for the four.

Weighing the Coke.—The box of crucibles is taken back to the weighing room, and the four coke remnants are weighed. To do this, they are placed on the watch glass and the balance effected with weights. Traces of carbon which adhere, in the form of a thin pellicle, to the surface of the crucible and cover are not added to the coke. They are reckoned as practically belonging to the volatile part of the coal. The weights observed are written down and added—showing the weight of the volatile matter of 10 grammes of dry coal. For example:

I.	0·821
II.	0·819
III.	0·822
IV.	0·819
Total	3·281
Volatile matter, per cent.	32·81

Incineration and Weighing Ash.—Each of the coke remnants is put into a flat platinum vessel, and kept for at least two hours in a muffle-furnace heated to moderate red. At the end of this time, there only remains a light body of ash, often having kept the form of the coke remnant. These ashes are successively turned out on to the watch glass; and the weight required to balance them represents the total combustible and volatile matter of 2·5 grammes of coal. The sum of these four weights is the complement at 10 of the amount of ash. Example:

I.	2·230
II.	2·227
III.	2·231
IV.	2·227
Total	8·915
Complement at 10	1·085
Ash, per cent.	10·85

This series of operations having been completed on the samples of medium and small, the composition of the unscreened coal is calculated on the classing, as previously set out.

NOTE IV.

Measure of Moisture in Sample of Coal.

Simple Process for Medium and Small Works.—The moisture is given by drying the coal in air at the ordinary temperature. A sample of coal is taken as previously described, and a weight of 1500 grammes is placed in a rectangular basin (in No. 3 zinc 0·4 mm. thick) 30 cm. by 40 cm., with an edge 5 cm. high. Such a basin weighs about 500 grammes; and the coal will be 1·5 cm. high. The tare of the basin must be carefully noted beforehand. The coal and basin are weighed and the total recorded. It is then placed in a cupboard under lock and key at the ordinary temperature, and free from dust; and it is stirred at least once in 24 hours with a small metal blade. After seven full days, experience shows that the drying may be considered as practically finished—the first decimal of the percentage of moisture no longer varying more than one unit at the maximum for a prolonged exposure to the air. The basin and its contents are then reweighed; and the difference obtained will enable the calculation to be made of the percentage of moisture in the sample. The weighing is carried out on scales susceptible to 1 decigramme when they are loaded with 2 kilos. in each tray. It is advisable to see that not the least particle of coal is lost; and it is useful to put the basin into a sufficiently ventilated and locked cupboard.

NOTE V.

Relation between Summary Tests and the Selling Value of Gas Coals.

The Commission thought it would be of interest to call attention to the indications that may be drawn from the summary tests (moisture, volatile matter, ash) made on coals to be carbonized. Whatever gas-works buys coal, or whoever sells gas or coke, the sale is fundamentally in its commercial aspect one of calories. The gas engineer is essentially a trader in calories. From this point of view appears the importance of fixing upon the total number of calories which we can find in such and such coal, and, if we have the choice between two coals, other things being equal, to know which of them contains the greater quantity. The already old and much-discussed question of dear or cheap coals is a badly put one, and its commercial significance relates, not to the price of coal, but to the calories contained. Pushing this consideration further, it is equally of interest, in a given coal, to separate the calories capable of being gasified from those remaining in the coke; their selling price not being at all comparable. To this second part of the problem it may be replied that it can be done only by carbonizing tests made under comparable conditions, and as nearly as possible to industrial practice. It is thus that the "Wertzahl" of the Germans was established—being the product of the yield in gas by the calorific power of this gas reduced to 1 kilo. of coal. But the summary tests (moisture, volatile matter, ash) can already inform us as to the total number of calories in a gas coal by means of the Goutal formula, the practical accuracy of which M. Mahler has ascertained by tests with the bomb within very extended limits, both within and beyond the proper gas coals. We cannot do better that quote exactly the note in which M. Mahler sets out this formula, and the verifications which he has made of it.*

M. Goutal proposed a formula intended to calculate the calorific power of coal by simply using the results of ordinary tests—drying, calcination, and incineration. In this formula, C represents the fixed carbon; V, the volatile matter; and *a*, a variable multiplier function of the volatile matter V^1 by the supposed pure fuel (without moisture or ash).

$$P = 8_2C + a\,V.$$

For all the fuels of which the volatile matter V^1 is below 40 per cent., the values of *a* are shown in the following table:—

V^1.	*a*	V^1.	*a*.	V^1.	*a*.
Per Cent.	Calories.	Per Cent.	Calories.	Per Cent.	Calories.
1 to 5	100	17	113	29	99
5	145	18	112	30	98
6	142	19	110	31	97
7	139	20	109	32	97
8	136	21	108	33	96
9	133	22	107	34	95
10	130	23	105	35	94
11	127	24	104	36	91
12	124	25	103	37	88
13	122	26	102	38	85
14	120	27	101	39	82
15	117	28	100	40	80
16	115				

The amount of the moisture is ascertained of coal in powder, 2 grammes of which are heated in a stove to 115° C. for an hour (the accuracy of the weight is verified by two weighings). The volatile matter is ascertained by briskly heating, above a Berzélius burner, 5 grammes of coal in an open crucible of about 30 cc. capacity. The flame ought to completely envelop the crucible, and when the illuminating volatile matter has entirely disappeared, the flame ought still to be continued for about three minutes. The ash is determined in a muffle on 2 grammes of fuel, slowly heated by a gradual rise of temperature.

As an example of the calculation to be made, let us take anthracite [Creusot] coal, the analysis of which is as follows:—

Fixed carbon	86·70 = C
Volatile matter	10·05 = V
Ash	1·45
Moisture	1·80

The volatile matter V^1 of the same fuel, supposed to be pure (without moisture or ash) would be:

$$\frac{V \times 100}{V^1 = C + V} = \frac{10{\cdot}05 \times 100}{86{\cdot}70 + 10{\cdot}05} = 10{\cdot}39,$$ corresponding to a value of *a* equal to about 129 calories.

Replacing the letters of the formula by this value, we shall have as the calorific power of Creusot coal:

$$P = 82 \times 86{\cdot}7 + 129 \times 10{\cdot}05 = 8406 \text{ calories.}$$

The same sample of coal gives by the calorimeter 8404 calories.

Generally, the difference between the calorific power thus calculated and that ascertained directly does not reach 1 per cent. of the actual power. An error higher than 2 per cent. is altogether exceptional—being noticed almost entirely with anthracites, or in the series of lignitic and oxydized coals. M. Goutal's formula can, therefore, be advantageously used for the approximate determination of the calorific value of a coal. It is interesting, because it is the only one, among numerous formulæ proposed up to the present, which is based exclusively on the results of ordinary tests which are always made on fuels.

NOTE VI.

Observations on the Nature of the Volatile Matter in Coal.

Volatile Matter Coming from Coal and its Waste.—100 grammes of unscreened coal dried at 100° C. can be decomposed theoretically into two parts: (1) 85 grammes (for example) of actual pure coal, combustible without residue, and in the composition of which are only carbon, hydrogen, oxygen, nitrogen, and perhaps traces

* P. Mahler, "*Etudes sur les Combustibles*" (1903), p. 83, "Determination of Volatile Matter and Calorific Power of Coals according to M. Goutal."

of sulphur; (2) 15 grammes of mineral waste composed of silica, lime, alumina, iron, and, in addition, sulphur in the state of pyrites or sulphate, carbonic acid in the state of carbonate, and, lastly, a little hydrated water.

This done, let us imagine that it would be possible to separate cold these two parts from one another, and then to submit them separately to calcination in a closed vessel. The calcination of the pure coal would give, for example:

	Grammes.		Per Cent.
Coke	57·8	..	68
Volatile matter	27·2	..	32
Total	85·0	..	100

As there is not any ash, the amount of volatile matter remains at 32 per cent. On the other hand, the 15 grammes of waste lose part of their weight, by reason chiefly of the decomposition of the carbonates, and, finally, we shall have, for example:—

	Grammes.		Per Cent.
Fixed matter	13	..	86·67
Volatile matter	2	..	13·33
Total	15	..	100·00

Adding together the two operations, we shall have:—

		Grammes.		Grammes.
Volatile matter	of pure coal	27·2	..	29·2
	of waste	2·0		
Fixed matter	coke from pure coal	57·8	..	70·8
	ash from waste*	13·0		
Total		100·0	..	100·0

Volatile matter, deducting for ash . . . 33·56

* In this statement, we have been obliged to neglect the very slight difference which may exist between the weight of the waste simply calcined in the crucible and the weight of the ash burnt in the air.

Ash being Deducted, there is more Volatile Matter in Unscreened Coal than in Pure Coal.—Further, the unscreened coal gives a greater proportion of volatile matter, ash being deducted, than that from pure coal. And it is necessary to observe that in this calculation we do not take into account at all a possible phenomenon which would tend still more to increase the yield of volatile matter from unscreened coal. In fact, in practice, the calcination of the coal and its waste is done simultaneously and in close contact. Under these conditions, the carbonic acid and the traces of water vapour given off from the waste are found in the presence of hot coke, and the following reactions arise:

$$H_2O + C = CO + H_2$$
$$CO_2 + C = 2CO$$

That is to say, a little fixed carbon may become gaseous in the form of water gas and carbonic oxide. Thus, the amount of volatile matter of unscreened coal (ash deducted) is not equal, as *à priori* might be thought, to the amount of volatile matter of the combustible and organic part of the coal. It is, on the contrary, normally higher.

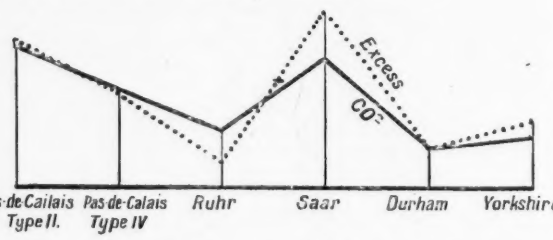
At the experimental works of La Villette, there is regularly made, in addition to the direct analysis of medium and small, that of a sample of coal as pure as possible, obtained by carefully separating small pieces of schist, pyrites, and stone. The coal thus got is called "pure" coal. Its amount of ash remains between 1 and 2·5 per cent. It can, therefore, without much error, be considered as a sample of the organic and combustible part of the coal which was defined at the beginning of this note. We ought, therefore, if we calculate the amount of volatile matter (ash deducted) of unscreened coal, on the one hand, and of so-called pure coal on the other, find that the latter is a lower figure than for the former. This is what, in fact, is observed. The following figures are a summary of all the tests made during two years by the Société du Gaz of Paris.

Source of Supply of Coal.	No. of Tests.	Results of the Coal Analysis.				Volatile Matter. Ash Deducted.		
		Unscreened Coal per 100 k. Dry.		Selected "Pure" Coal per 100 k. Dry.				
		Volatile Matter	Ash.	Volatile Matter	Ash.	Unscreened Coal.	"Pure" Coal.	Excess in Unscreened Coal.
Pas-de-Calais (type II.)	24	29·10	12·74	31·21	2·44	33·35	31·99	1·36
,, (type IV.)	11	34·36	12·68	37·78	1·78	39·35	38·47	0·88
Ruhr	23	30·91	12·00	34·18	2·08	35·12	34·90	0·22
Saar	14	34·19	12·20	35·77	1·75	38·07	36·41	1·66
Durham	46	31·01	11·49	34·15	1·49	35·03	34·67	0·36
Yorkshire	24	35·30	8·15	37·27	1·44	38·43	37·81	0·62
Average for the 6 coals	142	32·48	11·54	35·06	1·83	36·55	35·71	0·84

As has been seen before, the excess of volatile matter in the unscreened coal is explained chiefly by the presence in the waste of carbonic acid which is given off during the calcination, and is added to the proper volatile matter in the coal. This explanation is confirmed in a remarkable way by the result of the direct tests for carbonic acid in the coal. By means of a sufficiently large number of experiments, the average amounts of carbonic acid in coals from different coalfields have been ascertained. On comparing the figures in the last column of the above table with these average amounts, the remarkable agreement between them cannot be denied:

	Excess of Volatile Matter in Unscreened Coal.		Percentage of Carbonic Acid.
Pas-de-Calais (type II.)	1·36	..	1·35
,, (type IV.)	0·88	..	0·91
Ruhr	0·22	..	0·53
Saar	1·66	..	1·23
Durham	0·36	..	0·36
Yorkshire	0·62	..	0·46

This may be expressed diagrammatically thus:



It follows from what has just been said and from the findings set out in Note II. relating to the classing of coals: (1) That the presence of ash is a cause of increase in the amount of volatile matter (ash deducted); and (2) that the small (below 10 mm.) is nearly always richer in ash than the medium.

A mathematical corollary seems to follow from these two observations: The amount of volatile matter (ash deducted) of the small ought to be higher than that of the medium. Now, if we refer to the average results quoted above, we see it is exactly the contrary that is true.

General average:

	Medium.		Small.
Volatile matter	33·80	..	31·73
Ash	8·38	..	12·64
Volatile matter (ash deducted)	36·89	..	36·32

This apparent contradiction is explained by the fact that the presence of carbonic acid has been operative, not only in the unscreened coal, but also in the waste itself—that is to say, on the stones and schists found by hand-picking, either in the heap of medium or of small. But it has been ascertained that, with all the coals examined, the little schists and stones of the small are much less carbonated than the more or less large stones found in a heap of medium. The following table of figures on this point is complete and very conclusive:

	Percentage of CO_2 in Stones and Schists.		CO_2 Reduced to 100 K. of Ash, Resulting from Incineration of Waste.	
	Medium.	Small.	Medium.	Small.
Lens Pit No. 5	8·62	3·54	13·01	4·68
Lens Pit No. 4	11·51	5·50	16·50	7·20
Courrières Pit No. 2	7·70	3·12	14·15	4·32
Lens Pit No. 11	10·80	5·07	..	..
Bruay Pit No. 3	10·01	4·02	15·12	5·59
Alma Rhein Elbe	1·36	0·83	1·69	1·03
Consolidation	2·94	1·89	..	..
Average			12·69	4·56

While admitting that this characteristic observed in three of the principal categories of coal may be general, we see that the schists, which supplied the ash of the medium, contain per cent. of medium—

$$\frac{12{\cdot}09 \times 8{\cdot}38}{100} = 1{\cdot}01 \text{ of carbonic acid.}$$

And those which provided that of the small contain—

$$\frac{4{\cdot}56 \times 12{\cdot}64}{100} = 0{\cdot}58 \text{ only of carbonic acid.}$$

Thus, there is less waste in the medium than in the small, but this waste is considerably more carbonated—that is, it is richer in volatile elements than that of the small. It is not, therefore, surprising that the calcination of the medium provides more volatile matter (ash deducted) than that of the small. This particular circumstance—rather singular at first sight—can perhaps be explained by the fact that "in the productive area of the Nord and especially in the seams of gas coal, is found what the miners of the Nord call '*clayat*.' These are hard and more or less large rognons, formed of impure carbonate of iron. They are none other than the classic lithoid carbonated iron. These '*clayats*' in unscreened coal generally constitute larger stones than the schists coming from the roof or wall or earth layers between the seams. They are sometimes rather pyritic."*

Elementary Analysis of Coal.—The observations which have just been made can also be applied to the elementary analysis of coals.

* Instructions given by M. Paul Sainte-Claire Deville, Engineer to the Mines de l'Escarpelle, author of "An Investigation on the Schists and Calcareous Rocks of the Nord Coal Fields;" "Bulletin de la Société de l'Industrie Minérals," Vol. II., 1903.

The main object of this analysis is to show what are, in the organic and combustible part of coal, the relative proportions of carbon, hydrogen, and oxygen. This can be sufficiently ascertained by effecting the analysis by actual combustion, which gives directly the carbon and hydrogen. But an essential condition is, as recommended by Regnault, to operate on as purified a sample as possible, and of which the amount of ash does not exceed 1 to 1·5 per cent. The amounts of hydrogen and carbon are calculated. Deduction being made of the slight amount of ash, and by differences, the oxygen, combustible sulphur, and nitrogen are obtained. By deducting a constant (1·5, for example) for the sulphur and nitrogen, which vary very little in a purified sample, there remains an estimate of the amount in oxygen which is sufficiently informative. If the elementary analysis is done on an average rough sample of coal, the operation becomes much more complicated. Besides the actual combustion, there would have to be separated the quantities of combustible sulphur, carbonic acid (existing in the carbonated waste), and the nitrogen. Of course, the ash would have to be weighed. The following are the results of a complete analysis carried out on this method at the Zurich Laboratory on undried coal:—

Carbon	74·30	82·36
Hydrogen	4·59	
Oxygen	3·47	
Nitrogen	1·25	17·64
Sulphur (combustible)	0·64	
Carbonic acid	1·38	
Ash	12·95	
Water	1·42	
Total	100·00	100·00

The essential composition can be deducted from the combustible part:

Carbon	90·21
Hydrogen	5·37
Oxygen	4·42
Total	100·00
Hydrogen in excess of the quantity forming water with the oxygen	5·03

The purification of the coal can be carried out, as has been said, by hand and magnifying glass. It may also be effected by a very refined process, as was done by Professor Constam at the end of 1909. The coal is finely porphyrized and put in suspension in a liquid [tetrachloride of carbon] which enjoys the three following essential properties: It does not attack the coal; it is volatile without residue; and, lastly, its specific gravity (about 1·6) is midway between that of the coal and of the waste, so that the coal floats and the waste collects at the bottom of the vessel.

MANUFACTURE—REVIEW OF A YEAR'S IMPROVEMENTS.

The year gone by since our last meeting has given us information on the new systems of carbonization. The Woodall-Duckham installation of retorts at Lausanne consists of twelve beds each of four retorts, each bed being provided with its own producer and regenerator forming a unit of 3500 cubic metres per 24 hours. It has been carried out nearly to the model which was shown to us on our visit to Bournemouth in 1908. The retorts are moulded, while in other installations—*e.g.*, Birmingham, for 440 tons per day—they have become actual chambers made up of special pieces. The whole of the installations, finished or under construction, on this system now represents a capacity of more than 1700 tons of coal carbonized per 24 hours. It may be said that from now the process enters into practical industrial working.

The modifications of the Bueb type, noticed last year, replacing a bed of ten retorts by one of eighteen, appear to have given an economy in fuel of 2 to 3 per cent. on that used for beds of ten retorts.

Dr. R. Nübling, of Stuttgart, has studied very minutely the results given by vertical retorts, inclined chambers at Munich, Klönne horizontal chambers, and horizontal 6-metre retorts —the last-named being the system in use at Stuttgart. [See "JOURNAL" for April 2, p. 29.] He seems finally to come to the conclusion that horizontal retorts of 6 metres give results which are but little different from those of other systems. This led Dr. Bueb to reply by publishing in the "Journal für Gasbeleuchtung" of March 23, 1912 [see "JOURNAL" for April 2, p. 31], an investigation on "The Dessau Vertical Retorts in 1911." According to this, beds of eighteen retorts, of which there are twelve beds at the Mariendorf works, are drawn and charged in the same time as was taken for the old type of ten retorts, or, according to the author, an economy of 40 per cent. There follows a comparison applied to a gas-works having to make 2500 cubic metres in summer and 5000 cubic metres in winter, equipped either with beds of vertical retorts or with horizontal retorts. The result reckoned in money, unfortunately, seems to be applied to horizontal retorts with semi-regenerators; and it does not appear why these beds should not be provided, as well as the vertical retorts, with full regeneration—thus securing for each system a percentage of fuel reduced to what is recognized in practice as the best obtainable.

The arrangement at Stuttgart for the quenching of coke consists of a kind of perforated trough floating in a truck (full of water) which runs on rails in front of the bench. The same kind of thing is the proposal known as the "*Aeuve*" [stream], an application of which was seen last year at the Marseilles Gas-Works. This suggestion has also been adopted in other works; and its use seems likely to extend on account of its simplicity, and the certainty it offers for the carrying away, and simultaneous quenching, of the coke.

Another question which has again come to the front is the heating of retorts from a central producer. This process, which is indeed an old one, having been adopted nearly thirty years ago, and still existing, at the Vaugirard works, allows the use of low-grade fuel, which can easily be got anywhere. We call to mind that M. Bouvier, in the paper he read at the 1906 meeting, under the title of "Gas-Furnaces—Fuel Calculations," indicated the possibility of a method consisting in heating a gas-furnace "with a fuel gas made *ad hoc*, purified, stored, and sent pure and cold to the ovens by metal pipes of small dimensions, and introduced into the furnace, together with the air for combustion, by means of special burners, regulated by valves or metal taps." Certain works in England use this method; and the Kerpely producer is also an example of it at work at the Vienna Gas-Works. [See "JOURNAL" for April 23, p. 231.] It is a powerful apparatus, which in a tank, 2-metres diameter, can gasify in 24 hours from 15 to 25 tons of small coke or other fuel, while giving, by the cooling of its gas products, a certain amount of serviceable steam, not only for the producer, but for other purposes of the works. By a system of this kind for heating the ovens, the coke used per 100 kilos. of coal carbonized may amount to 10 per cent.

There does not appear anything else striking in other departments of manufacture to draw attention to.

RETORT-BED TESTS.

In the course of the year, the Commission has endeavoured to determine precisely the conditions under which it would be convenient to make tests on retort-beds, so as to render the results comparable, and to get some kind of common measurement which would free these tests from local factors, by having data as general as possible, influenced only by the system of retort-bed being tested. With this object, a programme of a working test for retorts has been drawn up and is given below, which the Commission recommends to be applied as strictly as possible. Tests made on this programme would provide materials, the comparison of which would furnish information which at the present time does not exist.

PROGRAMME OF COMPARISON FOR DIFFERENT RETORT SYSTEMS.

General Conditions.—The working test ought to be continued for at least one week. The quality of coal ought to be defined by its sources, size, and (if needs be) its summary analysis—moisture, volatile matter, and ash. The quality of the gas will be defined, after purification, as far as possible by its lighting power, gross calorific power, and the amount of carbonic oxide. The volume of gas should be always expressed as at 0° C. and 760 mm.

Normal Productive Power.—This is what the bed can make, in cubic metres of gas per 24 hours, when it is at its most economical working.

At Other Periods—The maximum output of the bed is when the make is the most that it is possible to have and to maintain in continuous working for at least one week. It will be expressed as a percentage of the normal productive power—for example, 110 per cent. of normal productive power. Other principal periods will be indicated by a make equal to 75 per cent. of the normal power, 50 per cent. of the normal power, and lastly, working without carbonizing (retorts in fire but not making gas).

Heating at Different Periods.—The heating will be expressed in kilos. of coke per 100 kilos. gross of the coal carbonized, and also per 1000 cubic metres of gas made, with or without the introduction of steam. It will, therefore, be given by two figures for each period, and one only when working without carbonizing, as follows:—

	Coke Used per Ton Carbonized.	Coke Used per 1000 c.m. Made.
Maximum (per cent. of normal power)	17 per cent.	540 kilos.
Normal power	16 ,, ,,	500 ,,
75 per cent. of normal power	20 ,, ,,	610 ,,
50 ,, ,, ,, ,, ,,	25 ,, ,,	760 ,,
Working without carbonizing	— kilos. per 24 hours.	

The coke ought to come as far as possible from the coal carbonized. The nature of the coke will be defined by its amount of pure carbon, ash, and moisture. Whether it is unscreened [*tout venant*] or free from dust should be indicated. From the weight of coke should be deducted the cinders and coke withdrawn from the ash-pans by sorting or washing—at least, if they are not put back into the producer. In any case the weight of this dry combustible residue should be indicated. The weight of water used in the ash pans per 24 hours should be given.

Labour.—The labour will be expressed in men-hours of actual work per 24 hours during the test. It will be shown by an absolute number, and in relation to a ton of coal carbonized per 24 hours. It ought to include all the time spent on the bed for the charging and drawing of the retorts, cleaning the lids, ascension-pipes, and hydraulic main, trimming, pricking, and keeping up the furnace, but excluding the time taken for sorting the cinders and the different cleaning-up jobs. The time will be ascertained by noting the exact time necessary for each of the operations named by following the men watch in hand. Multiplied by the number of operations during the test and by the number of men required for each operation, then divided by the number of days of the test, an absolute number of hours of actual work per man per 24 hours will be arrived at. Divided by the tonnage carbonized, it will be the labour reduced to a ton of coal carbonized per 24 hours.

Method of Charging and Discharging the Retorts.—Indicate the mechanical methods adopted (if any), the consumption of power, and necessary material.

Cost of Upkeep and Renewing Material.—The amount of upkeep ought

to be ascertained by taking account of the duration of the retorts and regenerators, and of the cost and frequency of remounting and repairs.

General Observation.—Under the heading of upkeep, as in all the above programme, only material for the actual carbonization ought to be included; the bringing of the coal to the bed and carrying away or quenching the coke should be excluded. In the case of horizontal retorts charged mechanically, or inclined or vertical retorts, the coal is reckoned as from the outlet of the storage bunkers placed above or close to the beds. Where retorts are charged by hand, the coal is taken from the front of the beds.

The Commission has endeavoured to ascertain if the application of this programme involves especial difficulties in carrying it out; and with this object, some of the members undertook to test it practically in their works. This test has shown that all parts of the scheme outlined above suitably correspond to the conditions to be defined. It is of particular importance that the time expressing the labour should be the actual time; and in this regard, the time of foremen (for example) should not be included, where their presence is required, not for such and such a system of retorts, but owing to the character of the staff. Tests strictly following the lines laid down will enable progressive information of the greatest interest to be obtained.

The following figures, selected from those obtained by the Commission, show the degree of agreement which can be attained, and are particularly brought out by the labour figures per ton at Works B and C, equipped with the same system of retorts. The results have been obtained, of course, entirely independently of one another.

Works A.—Beds of nine inclined retorts, 4·90 metres long, carbonizing in six hours. Retort charge, 330 kilos. Normal power.

Works B.—Beds of nine horizontal retorts, 6 metres long, carbonizing in eight hours. Retort charge, 477 kilos. 80 per cent. of normal power. De Brouwer machines.

Works C.—Beds of nine horizontal retorts, 6 metres long, carbonizing in from 10½ to 12 hours. Retort charge, 567 kilos. 75 per cent. of normal power. De Brouwer machines.

		Works A.	Works B.	Works C.
Coal	Moisture	3·88	Coal defined	2·51
	Ash	10·72	by its source	10·40
	Volatile matter	29·93	without analysis.	31·04
	Fixed carbon	55·47	..	56 05
		100·00	..	100·00
Gas made at 0° and 760 mm.		29·75	30·62	31·23
Heating: Coke used per 100 kilos. of coal carbonized.		20·40	18·40	17·50
Coke used per 100 c.m. of gas made		685 kilos.	603 kilos.	561 kilos.
Nature of coke		Unscreened from coal carbonized.	Unscreened from coal carbonized, part free from dust.	Unscreened from coal carbonized, free from dust through sieve of 35 mm.

Analysis of Dry Coke.

	Works A.	Works B.	Works C.
Moisture	5 35	—	3·42
Ash	14 52	8·41	15·06
Pure carbon	80·13	91·59	81·52
	100·00	100·00	100·00
Cinders	170 kilos.	67 kilos.	113 kilos.
Water in producer furnace per kilo. of coke used	546 grms.	504 grms.	464 grms.
Labour per bed and per 24 hours:—			
Actual work per man	8 hrs. 36 min.	6 hrs 18 min.	5 hrs. 31 min.
Per ton carbonized	43 min. 36 sec.	29 min. 21 sec.	29 min. 39 sec.

We do not comment on these figures, the nearness of which shows the interest there is, for most of the systems of retorts, of applying a comparison resulting from a uniform method of test; and how much information can easily be gathered from it, which will cut short the more or less sentimental estimates that have now to satisfy us in default of something better.

GAS APPLICATIONS.

The Commission on the Application of Gas mentions, with approval, the efforts made by the Société du Gaz of Paris in their negotiations with the Syndicat de la Boulangerie for the adoption of gas-heating in bakers' ovens. With gas at 20 c., a clear saving by the use of gas is shown. Attention is also being given to the design of new ovens specially arranged for baking by gas.

A second matter under consideration is the heating of small rooms by gas-radiators; the object being to find inexpensive apparatus, occupying little space, economical and strong, capable of rapidly heating small sets of rooms. A large number of different types of apparatus has been submitted, but no decision has as yet been arrived at.

The Commission has further considered a continuous hot-water heater, called "Le Marseillais," which is said to offer really practical advantages.

TECHNICAL INSTRUCTION.

The report of the Commission on Technical Instruction refers to the general movement and interest in the subject, and thinks that it would be useful to encourage the publication of technical books and manuals intended to facilitate the professional instruction of candidates as to the different departments of a gas undertaking of average or small size. A summary of such publications has been given to the Council of the Société Technique, which has decided to add to its list of prizes for 1913, awards for the best books or manuals of the following description:

(1) A prize up to 1000 frs. (£40) for the best handbook for foremen or head stokers of average works, having a maximum output of 10,000 cubic metres per 24 hours.
(2) A prize of similar amount for the best manual for an outdoor superintendent of works of like size.
(3) A similar award for the best book for the chiefs of public gas lighting of towns of less than 50,000 inhabitants.

Among the points to be particularly observed in such handbooks are precision and clearness of explanations; elementary instructions on methods of regulating apparatus; accurate information on the details of daily work; suggestions for effective upkeep and supervision; and advice as to the best times for the carrying out of periodical work.

If the results of such a competition are satisfactory, it might be extended to handbooks dealing with installations from the service-pipe to the apparatus, and also with the construction, repair, maintenance, working, and regulating of retort-beds.

DISTRIBUTION.

The Commission commence by referring to the report presented last year, and give an account of the progress realized since. Acknowledgment is made of the kindness shown by M. Rouland, the Managing-Director of the Paris Gas Company, in enabling the Commission to furnish these additional particulars, and for permission granted to visit the Company's high-pressure stations.

Dealing first with high-pressure gas, the Commission state that the first two installations were carried out in the Place de l'Opéra and the adjacent Rue du Quatre Septembre, with fourteen Graetzin lamps, of which six were of 4000 and eight of 1000 candle power, and in the Place de la Concorde with fourteen "Pharos" lamps of 1000-candle power. On Jan. 1, 1911, there were in use 21 Graetzin lamps of 4000-candle and 55 of 2000-candle power. At the end of the year, the Company had 368 high-pressure lamps in operation; and by the 1st inst. the number had been increased by 100. The complete programme for the present year will be regularly carried out; and by the end of December the number wil, be about 850. The hourly consumption is 6·5 litres per carcell mean hemispherical measurement. The lamps have undergone certain modifications, particulars of which are given by the Commission. The Company are considering the possibility of putting in burners of 1000-candle power applicable to all the large lamps in the city, in order to improve the lighting of the Place de la Concorde, the Place de la République, and the Place de l'Hôtel de Ville.

At the close of 1910, the length of high-pressure mains was only about 2¾ miles; whereas now it is nearly 17 miles, and by the end of the year it will be about 24 miles. In view of the development of the new system of lighting, the compressing station on the Boulevard Raspail, particulars of which have been given in the "JOURNAL," has been completely remodelled; and by this means the constancy of the pressure all over the line has been assured. Arrangements have been made for establishing two additional compressing stations. One is already in progress, and will start in about a month's time with a first unit of 35,000 cubic feet per hour. A second unit of like capacity will be added shortly.

In Paris, as is generally known, there exists a system of compressed air; and the Gas Company, as from the end of last year, have installed fourteen ordinary lamps furnished with Méker burners of 1000-candle power, working with compressed air supplied from the Popp mains, but at considerably reduced pressure. The application of low-pressure gas to high-power lighting has made some interesting progress by the grouping of several inverted burners in one lamp.

The report concludes with some tabulated particulars of the number and location of the lamps referred to in the report.

The Gas Pressure Question in New York.—The Public Service Commission of the First New York District have under consideration proposed regulations covering the pressure of gas in the borough of Manhattan. The regulations proposed are based on a report made after a lengthy investigation by Mr. W. A. Baehr, whose findings may be thus stated briefly: Minimum, 2 inches; maximum, 6 inches; maximum daily variation, 2 inches; maximum momentary variation, 5-10ths; maximum pulsating variation, 2-10ths. At the hearing, held on the 6th inst. in the rooms of the Commission, before Commissioner Maltbie, Mr. Baehr was the witness during the entire morning session. His testimony supported the regulations as being possible of execution after considerable work had been done by the Companies, and as desirable rather than immediate requirements with penalties. During the afternoon session, Mr. C. C. Simpson and Mr. W. R. Addicks testified on behalf of the Company regarding the desirability of omitting the maximum pressure, of lowering the minimum pressure, and of increasing the permissible daily variation to 3 inches. With reference to regulations covering momentary and pulsating variations, it was brought out that these were unique in the history of gas regulation, and that the recording instruments did not show the actual conditions at the consumers' appliances; gas pressures, too, being affected by barometric changes, wind storms, and notably by gas-engines fixed on consumers' premises. The hearing is to be continued.

ON SUPPLIES OF COAL IN REFERENCE TO THE ENGLISH COAL STRIKES.

By M. Masse.

[A Paper read before the Société Technique du Gaz en France.]

The strikes of the English coal miners, in consequence of their widespread and important character, are a feature of recent industrial conditions the significance and gravity of which cannot be ignored by gas makers. It is therefore of interest to reconsider the question of coal supplies with a certain degree of apprehension. The two points examined in the present paper are: (1) The possibility in the future of importing coals into France from America; and (2) the means of increasing stocks of coal in gas-works without making too great sacrifices.

It would seem that the question as to American gas-coal competing with that of France, England, and Germany can at once be answered in the affirmative. The European production is not in excess and prices show a tendency to rise rather than fall. In the United States, on the other hand, the enormous wealth of coal will certainly lead to over-production. The price is low, and though the transport facilities are inadequate at present, they could be rendered economical with suitable organization. The figures for the production of coal in various countries during the past 16 years show that the difference between England and the United States which was more than 2 tonnes 15 years ago is now less than 1 tonne. [See A in table.] Some light is thrown on the use made of national coal by the figures for the production of cast iron. In the case of the United States, for some years past it is greater than, or equal to, that in England, and appreciably greater than that in other European countries. [See B in table.]

	—	Year.	England.	France.	Germany	United States.	Belgium.
A.	Production of coal in tonnes per head of population .	1895	4·84	·73	1·98	2·50	3·14
		1907	6·06	·93	2·29	5 06	3·23
		1908	5·80	·95	2·33	4·23	3·18
		1909	5·79	·96	2·32	4·55	3·15
		1910	5·82	·97	2·35	4 86	3·18
B.	Production of cast iron in tonnes per head of population . .	1895	·196	·052	·103	·134	—
		1906	·247	·084	·196	·300	—
		1907	·226	·088	·203	·299	—
		1908	·201	·083	·183	·180	—
C.	Exports of coal in tonnes per head of population . . .	1895	·846	·027	·199	·053	·700
		1907	1·425	·029	·321	·130	·640
		1908	1·388	·027	·334	·145	·630
		1909	1·386	·028	·364	·131	·660
		1910	1·370	·032	·373	·149	·650
D.	Average price of coal at pit —francs . .	1883	6·9	12·5	6·5	6·0	10·1
		1895	7·4	11·0	8·3	4·8	9·4
		1909	10·0	15·2	12·7	5·9	14·3
		1910	10 2	14·5	12·4	6·6	14·6

As regards the export of coal, it is found that the English exports are greater than those from America exactly by the amount by which the English production exceeds the production in America. [See C in table.] It may thus be taken that in the United States the production corresponds with the national requirements, and that any increase in the former would lead to fresh exportation. On the other hand, the wealth of the United States in coal is very great—its fields covering 700,000 square kilometres, as compared with 31,000 in England. This great national source of supply has led to reckless waste of fuel for many years past; it being estimated that the waste is 50 to 70 per cent., or, according to another authority, 250 million tonnes per annum. But as European economical methods become more widely adopted in America, the production should become quite out of proportion with the consumption. In addition to reduction of waste, while the coal regions of the Eastern States were undergoing development, those in Canada took birth, and great things may be prophesied of the Alaska coalfields. Owing to a greater production in the not-distant future, America, it would seem, will be compelled to export a very considerable quantity of coal.

As regards price, M. Ed. Lozé has shown that for the past 25 years prices in European countries have steadily advanced, while in America, as a result of the methods of dealing with the beds, the use of mechanical handling, &c., the price has been kept very low, in spite of the high cost of manual labour in the United States. [See D in table.] In 1902, in Virginia, Pa., the price was about 6 frs. per tonne at the pit; in Kentucky, it was as low as 5 frs. It is thought if there were occasion—*e.g.*, fresh exportations—these prices could be further diminished.

In addition to these prices being low, they have increased within the past 29 years to a much less extent than corresponding prices in Europe, so much so that the difference in price between American and European coals has become still more marked. Thus the position at the present time is that there is a difference in the price at the place of production of 7 to 10 frs. between American and European coals, which difference may be further increased by a rise in price of the latter or a fall in the former. It is therefore not improbable that at some time in the future the difference may be as much as 12 frs.

In considering whether this difference will allow of American coals competing in the European market, the cost of land and ocean transport is, of course, an important factor. Another is the gas-making quality of the American coals, and a third the value to gas-makers of a supplementary source of supply to be drawn upon when conditions are disturbed in Europe. According to M. Lozé, the cost of transport from Pennsylvania or Western Virginia to the seaboard is from 7 to 8 frs., and about 12 frs. across the Atlantic. Though these costs appear large, they are, however, capable of reduction—in the former case by arrangement between the land transport companies and the coal owners, and in the second by the establishment of a fleet of transport vessels, by a system of bounties to the ocean service, and by taking advantage of return cargo which it would not be feasible to carry otherwise. In 1909, the formation of an American company to transport coal to the Mediterranean and carry back Spanish ore was mooted; the proposal being to export 20 million tonnes of coal and import 10 million tonnes of mineral.

As regards the quality of American coal from the gas-makers' standpoint, it seems they are superior to the European coals. The few tests which have been made, as embodied in the following tables, allow of some idea being formed of the degree of superiority.

Comparative Analyses and Tests of English and American Coals (Société du Gaz of Marseilles, 1900).

—	Montana	Kanawha.	Westmoreland	Londonderry.	Wearmouth.	Lambton.
Moisture	1 30	1·80	1·40	1·60	2·00	1·60
Volatile matter . .	36 50	33·50	35·60	31·20	32·50	28·50
Coke	63·60	66·50	64·40	68·80	67·50	71·50
Percentage of ash in { Coal .	7·51	5·65	4·83	6·19	5·73	7·15
Coke .	12·00	8·50	7·50	9·00	8·50	10·00
Yield of gas at 15° and 760 mm. in cubic metres . .	339	332	342	310	325	300
Grade of gas (litres)	99·62	102·90	100·48	102·06	102·48	102·32
Yield in carcels at 15° and 760 mm. .	3·377	3·226	3·405	3·037	3·172	2·903
Yield in coke (kilos.)	650	640	640	680	680	700

Analysis of Ten Coals from Fairmont, West Virginia, made by M. Kaas, of the Geological Survey ("The Ultimate Composition of Fairmont Pittsburg Coal," July, 1908.)

—	Moisture.	Volatile Matter.	Fixed Carbon.	Ash.	Sulphur.
1	1 94	34·68	57·66	5·72	0·80
2	1·76	35·06	56·54	6·64	1 63
3	1·58	35·56	55·44	7·42	2·03
4	1·32	37·06	54·40	7·22	2·49
5	1·52	37·80	54·26	6 42	2·52
6	1·72	38·34	53·90	6·04	2·56
7	1·28	38 12	52·46	8·14	3·14
8	1·45	38 91	52 42	7·22	3·26
9	1·21	39 78	51·90	7·11	3·54
10	1·40	39·30	51·80	7·50	3 68

These coals have been tried on the industrial scale by the Municipal Gas-Works of Detroit, and have given about 32 per cent. of gas of the following composition:—

	Per Cent.		Per Cent.
Illuminants . . .	3·4	Carbonic oxide . . .	8·5
Marsh gas	29·7	Carbon dioxide . . .	2·7
Hydrogen	48·9	Oxygen and nitrogen .	6·8

We have ourselves received coal from Cambrian, Pa., the analysis of which (the dried materials) yielded the following results:—

	Nov., 1908. Per Cent.		Oct., 1910. Per Cent.
Moisture	2·35	..	2·16
Ash	4·75	..	1·30
Volatile matter	36·61	..	40·90
Sulphur	0·80	..	0·98

From these considerations, it would seem that there is nothing impossible or improbable in attaching importance to the use of American coals in Europe. The facts which condition such use are those of economics or even of international politics.

Increased Supplies of Coal in Gas-Works.

In considering the question of increasing stores of coal as a provision against the cessation of supply due to strikes, it must be borne in mind that at the present time gas-makers, according to the terms of their contracts, have to hold a stock of coal equivalent to six weeks' make, involving extra capitalization and cost of working. Land occupied for coal storage, with plant for handling the stock, represents a capitalization ranging from 4 to 10 frs. per tonne of coal stored, to which must be added that corresponding with the actual cost of the coal. Comparison of these charges relatively to the whole capitalization of a gas company shows that the keeping of a stock of coal sufficient for six weeks means an increase in capitalization of from 1 to 2·4 per cent. This in itself is a heavy enough price to pay; but the holding of much stock involves other expenses resulting from the tendency of coal to heat when kept in the air and to lose some of its gas-making quality. Such reduction may amount to from 3 to 12 per

cent. in twelve months. Moreover, this tendency to heat, and even to give rise to combustion, makes it necessary to disperse the stock at least once each year. Such disposal of stock and the accumulation of fresh stock, proceeding as it does at the same time as the regular working of the retort-houses, involves the gas-maker in considerable and costly labour.

The tonnage handled by way of taking into, and removing from, stock (apart from the coal which goes directly into the retort-house) varies from 90 to 120 per cent. of the total tonnage distilled. On the other hand, in gas-works possessing the best mechanical plants, the taking into or out of stock costs at least 0·30 fr. per tonne. With such heavy charges, it is easy to understand the obstacles in the way of holding large extra supplies of coal. Whatever the method adopted, there must be an increase in the capitalization of the company. But if by some process the yearly taking out of stock could be avoided, the economies so effected would produce in part the interest on the increased capitalization. Storage under water is one solution of the problem if, as seems to be the case, storage of coal in this way would absolutely ensure the retention of the gas-making qualities of the coal.

According to Mr. J. Macaulay, of the Alexandra Docks and Railway Company, Newport, coal stored under water for three years depreciated only 1·6 per cent.; and excellent results have also been credited to this method in the United States, as also in Stettin, Germany, where a reservoir accommodating 20,000 tonnes was to be built on the banks of the Oder. In regard to this solution of the problem, it must be borne in mind that plant for dealing with coal stored in air is not necessarily convertible to the new method; that the first cost of such method of storage would be much greater than for that in air; and that so far no absolute data are available as to the behaviour of such wet coal in the retorts. In these circumstances, it seems preferable to adopt a half-and-half solution of the problem, which I will here call the "method of mixed stock;" the stock being divided into two parts for storage in air and under water respectively. That in air is to be distributed each year; that under water to be used only in special circumstances. With the stock in air reduced to its minimum, heating would not be feared, and the cost of handling would be greatly reduced. To take as example a works distilling 289,000 tonnes per annum, and purchasing its supplies six weeks in advance, its minimum stock in air is thus 38,000 tonnes; its maximum, 88,000 tonnes Apart from the coal entering the retort-houses directly, it has to handle in the course of the year 250,000 tonnes—a by no means abnormal quantity. On the mixed stock system, the quantity to be handled would be about 11,000 tonnes, representing a saving of 35,000 frs. This would be secured by immersing 40,000 tonnes, and includes no allowance for better yield. This saving, capitalized at 5 per cent., means 700,000 frs., to be devoted to the construction of reservoirs and plant, and to increasing the total stock of coal, without making further charges on the undertaking.

ESTIMATION OF NAPHTHALENE IN GAS AT THE PARIS GAS-WORKS.

By M. Laurain.

[A Paper read before the Société Technique du Gaz en France.]

The estimation of naphthalene in coal gas consists in determining the weight of this substance present in the state of vapour per cubic metre of the gas which is passing at a given time through any given part of the distribution system. The estimation is invariably an operation calling for the most scrupulous care. It is first of interest to consider which are the points in the distribution system at which the estimation of naphthalene is of importance. In the distillation of coal, the quantity of naphthalene produced per cubic metre of gas is enormous relative to that which is sufficient to saturate this volume of gas at normal atmospheric temperatures. When passing from the intense heat of the retorts to the temperature (T) of the cooling plant, the gas would lose, even by simple condensation, all naphthalene supersaturating it at T—in other words, about 99 per cent. of the total.

If there were no tar, the condensers would retain only solid crusts of crystallized naphthalene, and the gas at the outlet would continue saturated at the final temperature T. But the quantity of tar at the outlet of the hydraulic main amounts to about 100 grammes per cubic metre; so that if the condensation is such that this tar cannot separate from the gas before complete cooling to T, the naphthalene will dissolve in it, becoming itself condensed, and at the outlet of the Pelouze washer the gas will be saturated not at the maximum tension produced at t by the pure naphthalene, but at the lower tension produced at the same temperature by the solution of naphthalene in tar—this latter, since it remains very fluid, being of low strength. Hence the proportion of naphthalene in the gas at its outlet from the Pelouze washer will be smaller the lower the temperature at which the gas is washed and the larger the quantity of tar employed in the process. An estimation of the naphthalene in the gas at the outlet of the Pelouze washer is thus of considerable interest to the gas maker.

The figure obtained is usefully interpreted only by reference to a reliable table or chart giving the amounts which saturate a cubic metre of gas at various temperatures. For example, an estimation may show that at a temperature (T) of 18° C. at the outlet of the Pelouze washer, the quantity of naphthalene per cubic metre is 166 milligrammes. These two figures by themselves do not amount to much; but they become informative on learning from a chart that at 18° C. gas could hold naphthalene up to 0·319 gramme—the latter being the figure for saturation. From the same chart it is seen that 0·166 gramme is the quantity producing saturation at 12°. Whence it follows that the gas in question would become dangerous to the mains only in pipes having a temperature lower than 12°. In this case, 12° is the critical temperature θ of the gas examined. It is the only figure which is really of value; the actual quantity of naphthalene serving only to find θ in the chart.

As will be seen later on, it is possible to design and construct an apparatus allowing of this critical temperature being directly determined, and so avoiding the tedious methods of determination of the weight of naphthalene in the gas, as also the use of a table of maximum quantities, the universal adoption of which throughout the globe cannot be enforced. Thus it will be understood that the estimation at the outlet of the Pelouze washer and the temperature θ, deduced therefrom, serve to show the degree to which true condensation has been carried out. Naturally, the lower θ is than T, the better the condensation.

In the case when the gas leaves the Pelouze washer at T° saturated with naphthalene vapour at the critical temperature θ°, it has still, before reaching the town mains, to traverse the works system. In this passage it may encounter pipes of lower temperature than θ. These latter will be covered with naphthalene, which in some cases collects after a time in considerable quantities, which are liable to give trouble. Thus the quantity of naphthalene at the inlet to the town mains may be different from that when the determination is made at the outlet from the Pelouze washer. Therefore a fresh estimation, or a fresh determination of the critical temperature, requires to be made with a view to discovering the risk run in the town mains. Such risk will be proportional to the number of degrees by which the new critical temperature exceeds the probable mean temperature for the time of year in the least protected parts of the mains.

Some data are available as regards the average temperatures at different seasons of the year. From daily observations made from 1887 to 1892 by the Mains Department of the Paris Gas Company on the temperature of the subsoil at two spots and at depths respectively 60 cm., 1 metre, and 1·4 metres under a pavement, it was found that a minimum temperature was reached towards Dec. 15, and was maintained without much variation up to April 15. The temperature then rises rapidly up to the maximum for the summer months, which keeps fairly constant from June 5 to Sept. 25. The winter maximum varies between 4° and 7°; that for the summer, between 16° and 20°. Hence, as a rough approximation, it may be said that the deposit of naphthalene is not to be feared in the mains if the critical temperature is below 5° in winter or 15° in summer.

Most frequently—particularly in works where condensation in the heat is badly done—it is found that the quantity of naphthalene in the gas is reduced to an appreciable extent between the condenser and the supply to the town mains, or that the critical temperature of supply is considerably lower than that at the outlet of the Pelouze washer. The difference represents the naphthalene deposited at different points in the works mains and in the gasholders.

In referring briefly to several methods hitherto employed in the estimation of naphthalene in gas, mention should be made of Fritsche, of St. Petersburg, who, in 1862, prepared picrate of naphthalene. This was followed by Berthelot's experiments on picrates five years later; Kuster, prior to 1900, being the first to employ picric acid in the estimation of naphthalene. The method has been developed and more or less improved by subsequent workers, among them by Colman and Smith (1900), Stavornius, Jorissen, and Rutten (1909), and, lastly, by Arpad, Wein, and Julius Schrecker (1911). During the past three years, M. Desprez, of the Paris Gas Company, has undertaken a very minute investigation of this question. He has tested, modified, and improved the process of Colman and Smith, and has worked out a method the manipulation and precautions in using which he has described in detail. Only when these are observed can dependence be placed on the accuracy of the method. Though these researches may be of interest from the scientific standpoint, it must nevertheless be said that the estimation of naphthalene by the picric-acid method would appear to be a lengthy and delicate operation.

In reference to the method in which the naphthalene is dissolved by heavy anthracene oil, such as is generally used in the Bueb washers, the oil should be very slightly volatile (not taken up by the gas at normal temperatures), should not contain naphthalene, and should remain fluid even at low temperature. A method of preparing a suitable oil is to free any heavy coal oil, by distillation, from products which boil below 270° a 280°, and cool and filter at 0° in order to remove substances solid at this temperature. The Bueb oil is doubtless prepared in this manner; but for the estimation of naphthalene there is no need to add the usual 4 per cent. of benzol.

In tests made of this method by the experimental works in 1904 and 1905, gas at the rate of about 300 to 350 litres per hour was bubbled night and day through the oil—about 200 cubic metres into 600 grammes, contained in three Woulfe bottles in series. On fractional distillation and double rectification of the oil, the naphthalene was obtained (crystallized and white) and weighed.

The results are no doubt a little too high—the naphthalene which is weighed not being very pure. Its melting-point is not more than 60° to 65° C. Nevertheless, the figures obtained in summer and winter with gas from different works of the Company taken at the outlet of the Pelouze washer show relative accuracy among themselves.

In regard to a somewhat similar method—that of M. Dupasquier, 1908 Congress—the absorption is also done by bubbling, but instead of extracting the naphthalene by distillation, a measurement is made of the maximum quantity of finely-powdered naphthalene which will dissolve (1) in 100 grammes of oil from the bottles and (2) in the same weight of virgin oil. The difference is taken as the weight of naphthalene left by the gas in the oil. The author of the method has somewhat simplified it by drawing up a table of the quantities of naphthalene dissolved in 100 grammes of virgin oil at the ordinary temperatures. The method has not been examined at the experimental works, owing to the work having turned in another direction since 1908.

Methods of Direct Cooling and Condensation.

The following experiment was made in the experimental works in April and May, 1905, by M. Sainte-Claire Deville. A "naphthalene trap" [*piège à naphtaline*], as shown in fig. 1, was constructed. It consists of a large glass vessel E, 10 cm. diameter and 50 cm. high. Inside are seven shelves giving a very broken course to the gas. Each is formed by a spiral plate of copper tube; connection being made between the shelves by vertical lengths of the same tube, so that a stream of water entering below from D will be discharged from the top at B after having successively traversed the spirals of the seven shelves. These latter are further covered each by a disc of metal gauze fixed to the connecting copper tubes by iron wire. The water being at a temperature of from 2° to 3°, and running through at the rate of about 25 litres per hour, the gas is passed through the vessel, from the top downwards, at the rate of about 600 litres per hour—that is, at the maximum speed of the experimental meter which was used.

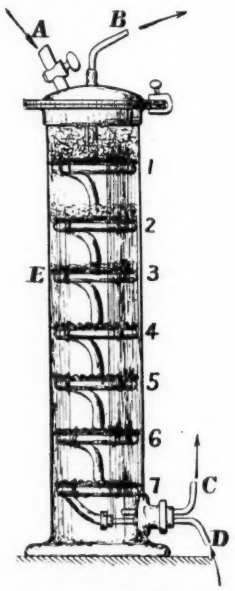


Fig. 1.—Naphthalene Trap.

Under these conditions, it was noticed that at the end of a short time, naphthalene crystals appeared on shelf No. 1, first encountered by the gas. These deposits increased regularly; and, after the passage of 100 cubic metres of gas, the space between the cover of the vessel and the first shelf was filled by naphthalene. A smaller quantity likewise accumulated on the second shelf. Hardly any crystals were visible on the third, while there was absolutely no deposit on the last four shelves. This shows that the first three shelves have stopped all the naphthalene which is condensable at 2° to 3°. The gas passed the last four shelves without choking them in the slightest; hence, *a fortiori*, it would withstand tests of the same nature, but much less severe, which it would meet in the mains. It should be added that a pad of cotton wool placed below shelf No. 7 did not retain any trace of naphthalene dust. It may therefore be concluded that, under these conditions, the naphthalene is condensed as is water on a cold surface (on Watt's principle), and that there is no formation of microscopic crystals held in suspension in the gas in cloud form. The small apparatus described evidently contains the germ both of a method for the industrial removal of naphthalene and of a process for its estimation.

In employing the "trap" for estimating naphthalene in gas, M. Gensse of the experimental works, has worked out a smaller model by means of which the whole of the naphthalene in excess of that saturating the gas at the temperature $t°$ of the water in the coil can be definitely removed. The apparatus is then washed with alcohol, the naphthalene precipitated with water, filtered off, dried, and weighed. It would take too long to point out the many precautions taken in ensuring accuracy in the use of this method. The test lasts from eight to ten hours, using 3 to 4 cubic metres of gas. To the weight of the naphthalene found is added the weight which, at the temperature $t°$ of the coil, saturates the gas. This is taken from a table, and the total weight, calculated for cubic metres of gas at 0° and 760 mm., expresses the quantity of naphthalene vapour in the gas.

To this method, as to the others described above, there are three objections. They give the average quantity of naphthalene in the gas measured over a period which is so long that the temperature of condensation can vary considerably; also they require the close attention of the operator over this lengthy time; and, lastly, they all depend on the accuracy of the table of quantities of naphthalene in gas at the various temperatures. Thus none of the processes is of service in making frequent measurements of the "naphthalenic" state of the gas with the same facility as its hygrometric condition can be observed.

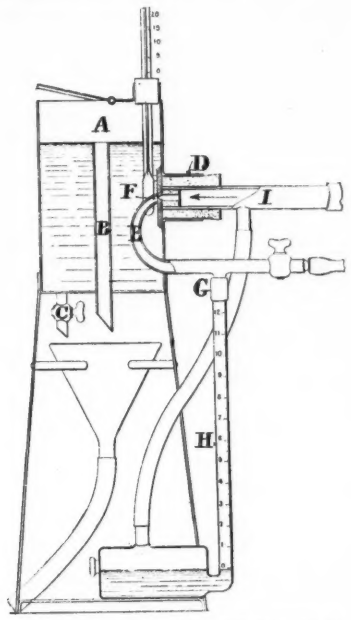


Fig. 2.—Apparatus to Show Amount of Naphthalene Deposited.

Experiments have therefore been made in the experimental works in order to perfect a direct and rapid method of determining the critical temperature of the gas in respect to the deposition of naphthalene. The apparatus used for this purpose is still of the "trap" type; but, instead of depositing and weighing the quantity of naphthalene separated from a large volume of the gas on cooling to a low known temperature, the test consists in finding to what temperature it must be cooled in order to cause the naphthalene to commence depositing—the principle, in fact, of the Alluard hygrometer. The gas is caused to pass through a very fine passage at a pressure shown by a differential manometer. The passage can be heated or cooled as desired. The apparatus is designed to subject the gas to sharp access of cold, and so that the slightest deposit obstructs the passage. The working of the apparatus will be clear from the following description: It consists of a copper cup A, of 300 c.c. capacity, holding water up to the level of the overflow B. An outlet cock C allows of the water being rapidly discharged when required. In one of the flat vertical walls of the cup a circular aperture is cut, of 2 centimetres diameter; the centre of the aperture being about half-way up the side of the cup. A tubulure D is soldered to the edges of the aperture. The latter is further closed by a copper washer, about 2 mm. thick, soldered to the inside of the cup. This washer is pierced at its centre by a small conical hole, which forms the passage through which the gas is caused to pass. The size of the hole is such that it causes a loss of pressure in the gas of from 30 to 40 mm. of water for a supply of 50 to 60 litres per hour. A copper tube E, of 5 mm. internal diameter, is fixed section-wise against the washer, and serves for the removal of the gas which has passed through the passage F. This tube is curved inside the cup, through the wall of which it afterwards passes. It is continued outside, in order to conduct the gas to a small burner (not shown in the drawing); a side tube, at G, connecting it with a branch from the manometer H. The tubulure contains a good cork, through the centre of which passes the glass tube I, by which the gas to be tested is delivered. Another small cork is embedded in the tube I which makes contact with the washer, and has a central aperture the diameter of which is not greater than that of the base of the cone. By these means the gas is prevented from being subjected to the temperature of the cup before it comes in contact with the inner wall of the conical passage. The tube I connects with the differential manometer by the side tube shown.

The test is carried out as follows: The gas-inlet cock is opened and the burner lighted. The supply is then adjusted so that, with

the whole apparatus at the normal temperature, the manometer registers a loss of pressure of 30 to 40 mm.; the amount being noted. The cup is then filled with water at the temperature of the room, and small pieces of pounded ice or freezing salt put into the cup. The thermometer gradually falls, and a point is reached when the naphthalene crystals commence partially to block the passage. The manometer indicates an increase in the pressure-difference; and as soon as this increase reaches 15 to 20 mm. the water is not further cooled, but is left to warm up again to the temperature of the room.

Starting from the moment when the manometer begins to rise, a note is made, at frequent intervals and with great care, of the readings of the thermometer and manometer at the same instant. The loss in pressure, after having risen to a maximum, commences to fall. As soon as this falling phase is marked, the test is finished. The critical temperature at which the gas is saturated is the mean of those observed during the whole time that the manometer stood steady at its maximum. A check test may be made if necessary, by again introducing ice into the cup and repeating the operations.

After a test, all that is necessary, in order to remove all trace of naphthalene from the passage, is to re-heat the water a few degrees before turning out the gas. This is conveniently done by moving a ball of iron, heated in a burner, in the water. It will be understood that the critical temperature observed is that which the thermometer indicates, while an obstruction which has been previously induced is kept constant, neither growing nor being volatilized by the passage of the gas.

The gas must be at least partially dried with chloride of calcium before entering the apparatus. Moisture in the gas to an extent which would deposit in the tube D at the minimum temperature would leave the naphthalene moist, with the result that its re-evaporation at temperatures higher than the critical temperature would be affected.

The apparatus is well suited for the study of the much-debated question as to the influence of the condensation of water-vapour on the simultaneous condensation of naphthalene. If it is wished to ascertain the actual weight of naphthalene in the gas from the observation of the critical temperature [by reference to the table], the test must be made on the dry gas, since the table is likewise drawn up for this latter.

In reference to tests made at the outlet of the Pelouze washer, it is obvious that the gas entering the apparatus should have been freed from all tarry particles which might have escaped the action of the condenser. Also, it should be free from ammonia, and so avoid the possibility of the deposition of ammonium carbonate with the naphthalene. Lastly, the gas must not be cooled at any point in its course between the large outlet-pipe of the Pelouze from which it is drawn and the inlet-tube of the test apparatus.

The arrangement shown in fig. 3 allows of these conditions being readily fulfilled. The thermometer A is passed through the outlet pipe of the condenser. A tube B, of glass, or better of fibre, is fixed in the pipe, and encloses a tuft of cotton wool *a*, some pumice *b*, impregnated with sulphuric acid, and a few pieces *c* of calcium chloride. Cotton-wool packing surrounds the short tube connecting B with the test apparatus C.

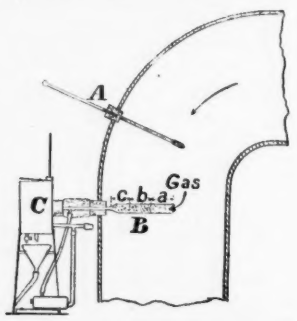


Fig. 3.—Application of the Test to the Outlet of a Pelouze Washer.

Reference has frequently been made in this paper to the chart or table giving the quantity of naphthalene which saturates coal gas at various temperatures. There are known to us four such tables giving the quantity of naphthalene in the state of vapour in a cubic metre of gas at the pressure of 760 mm. That of Audouin dates from 1870; that of Baron, from 1888; that of Allen (in the "Journal of the Chemical Society,") from 1900. In 1910 and 1911, M. Gensse made a series of experimental determinations, carried out, as were those of the previous workers, by the method of direct evaporation. A weighed tube containing an excess of naphthalene is placed in an enclosure kept at a constant temperature $t°$. A volume V of dry air is passed over it, and emerges saturated with naphthalene at the temperature $t°$. The loss of weight in the tube is taken as equal to the weight saturating the gas; the V litres of air being measured at the temperature and pressure prevailing in the meter of the aspirator during the test. A simple calculation gives the weight P of naphthalene which saturates exactly one cubic metre of dry air at 0° and 760 mm. From this it is easy to calculate the maximum vapour-tension of naphthalene at $t°$, taking Dumas' value of the vapour-density of naphthalene—viz., 4·582. But it is the weight per cubic metre which is of service in practice.

According to Allen, the weights which are capable of saturating gas at the different temperatures are the same also with dry air, hydrogen, marsh gas, and acetylene; also the presence in coal gas of more or less benzol vapour does not affect the quantities.

The table drawn up by the officials at the experimental works as the result of their tests of 1910-1911 is as follows:

Temp.	Naphthalene per Cubic Metre of Saturated Gas.	Temp.	Naphthalene per Cubic Metre of Saturated Gas.	Temp.	Naphthalene per Cubic Metre of Saturated Gas.
Deg.	Gms.	Deg.	Gms.	Deg.	Gms.
− 21·50	0·0	16·16	0·266	40·36	2·831
− 21·00	0·0	16·30 { 16·20	0·263 } 0·270	41·36	3·036
− 12·04	Not weighable	16·54	0·282	44·10	3 749
− 9·41	,,	21·67	0·482	46·00	4·356
+ 1·16	0·0610	26·67	0·803	49·13	5·589
3·24	0·0632	27·33	0·852	51·05	6·615
3·50	0 0681	27·59 { 27·66	0·884 } 0·873	52·96	7·873
6·32	0·0890	27·84	0·883	59·00	12·873
8·88	0·123	31·00	1·165	60·95	14·665
10·60	0·148	31·05 { 31·10	1·191 } 1·178	61·55	15·197
11·00	0·148	32·67	1·377	65·00	19·507
12·14	0·175	34·74	1·695	79·79	51·378
13·90	0·214	39·51	2·595	80·64	57·818

A comparison of the above table with those obtained by the previous experimenters shows that in the case of temperatures below 25° M. Gensse's figures are appreciably lower than those of Allen, and *vice versâ* in the case of temperatures above 25°. It would lead us too far to consider in detail the two sets of measurements, and to give our reasons for the belief that the values obtained in the experimental works are to be preferred to those of Allen. We may, in conclusion, give the table for practical use worked out from the tests made in the experimental works.

Temp.	Naphthalene per Cubic Metre of Saturated Gas.	Temp.	Naphthalene per Cubic Metre of Saturated Gas.	Temp.	Naphthalene per Cubic Metre of Saturated Gas.
Deg.	Gms.	Deg.	Gms.	Deg.	Gms.
0	0·054	22	0·516	44	3·733
1	0·057	23	0·558	45	4·059
2	0·061	24	0·614	46	4·382
3	0·066	25	0·672	47	4·747
4	0·070	26	0·736	48	5·174
5	0·076	27	0·811	49	5·608
6	0·086	28	0·886	50	6·093
7	0·096	29	0·973	51	6·646
8	0·108	30	1·072	52	7·262
9	0·123	31	1·175	53	7·941
10	0·138	32	1·294	54	8·660
11	0·154	33	1·423	55	9·456
12	0·173	34	1·594	56	10·280
13	0·195	35	1·747	57	11·121
14	0·219	36	1·934	58	11·980
15	0·246	37	2·112	59	12·867
16	0·270	38	2·318	60	13·772
17	0·306	39	2·515	61	14·719
18	0·340	40	2·734	62	15·683
19	0·378	41	2·960	63	16·703
20	0·417	42	3·196	64	17·765
21	0·461	43	3·461		

In using this table, it should not be forgotten that the weights are reduced to one cubic metre of gas at 0° and 760 mm. Thus, gas saturated at 20° contains 0·417 gramme of naphthalene per cubic metre—that is to say, 0·417 gramme is the weight of naphthalene contained in

$$1 \text{ cubic metre } (1 + 20\,\alpha) = 1{\cdot}073 \text{ cubic metres}$$

of gas at a temperature of 20°. A cubic metre of this same gas measured at 20° would only contain

$$\frac{0{\cdot}417 \text{ gm.}}{1{\cdot}073} = 0{\cdot}389 \text{ gramme of naphthalene.}$$

POLLUTION OF GAS IN HOLDERS AND THE REMOVAL OF CARBON BISULPHIDE.

By M. GUILLET.

[A Paper read before the Société Technique du Gaz en France.]

The pollution of gas, which has been properly purified, on storage in the gasholder to such an extent that it strongly darkens lead acetate test-paper has been the subject of recent experiments by the writer, as the result of a case of this kind having been brought forward by a colleague, who last year suggested that the formation of sulphuretted hydrogen by micro-organisms is not merely a hypothesis but has been observed in practice. In the case he examined, it did not seem to afford an explanation. The gasholder of 1500 cubic metres, was of the sealed tank type and obtained a little water only from time to time. It had produced pollution for several years, and the defect had become gradually more pronounced in spite of the application of the

usual remedies—such as oil on the surface of the water, sulphate of iron, &c. The water in the tank was used for cooling a gas-engine, which was occasionally running, by means of the usual thermo-syphon arrangement. A thermo-syphon had also been installed to provide against the freezing of the water in winter; and the two together had produced a certain quantity of rust in suspension in the water. The latter did not give the reaction of alkaline sulphides. It was muddy and of yellowish tint—depositing flocculent ferruginous matter. It contained very little sulphate. Drawn from the bottom of the tank, the water was blackish; and, when acidified, it gave off the odour of hydrogen sulphide—the flocculent matter (evidently ferrous sulphide) at the same time dissolving. My experiments were directed towards reproducing experimentally these conditions.

Ordinary purified gas was bubbled into a flask of 250 cc. and led off by a vertical tube, capped by a test tube which was supported by a loosely fitting cork. A strip of lead acetate paper placed in the vertical tube was thus exposed to the gas but protected from the outside air. By means of a set of gas-cocks, tests could be made in a whole series of flasks, each being connected with a check-flask containing only water, and causing no alteration of the test paper. Each experiment was made with the paper checked in this way; the lead acetate paper being changed every twenty-four hours with the exception of those in the test-flasks where no darkening took place. Such long action of the gas was adopted, contrary to the standard practice, as the object was to obtain indications of minute amounts of pollution.

In order to afford an idea of the degree of darkening of the paper the number 0 was adopted to describe paper which remained white after 24 hours; 5, to indicate that becoming fully dark with a metallic appearance; and 2, 3, and 4, for intermediate degrees of blackening. Thus in the results given below, each figure represents the lapse of 24 hours.

With the object of finding whether ordinary purified gas by contact with the wrought-iron plates of the gasholder and the water in the tank, can become so polluted with hydrogen sulphide as to darken test paper, 100 cc. of water from the tank were placed in the flask with ordinary iron turnings weighing about 5 gms. In another flask were placed also 100 cc. of water from a tank which gave rise to no contamination, and a similar quantity of iron turnings. In a third flask the conditions were the same, except that ordinary drinking water was used. The results were as follows:—

1. Water from polluted gasholder with iron turnings. . . .	1	2	3	3	3	5	5	5	5	5
2. Water from non-polluted gasholder with iron turnings .	1	1	3	3	4	5	5	5	5	5
3. Town water with iron turnings.	0	2	2	2	1	2	5	5	5	5
4. Check flask, town water . .	0	0	0	0	0	0	0	0	0	0

The different waters thus gave the same result when iron was used; the gas, passing from the flasks at the end of six or seven days being so charged with hydrogen sulphide that it completely darkened the test paper. After fifteen days' continuous passage of the gas, a fresh paper reached the No. 5 tint in less than two hours. In a later test of clean gas, it reached this depth within the standard time of fifteen minutes.

Similar tests were made with water from the bottom of the gasholder, but without the iron turnings:

5. From bottom of tank (muddy yellow) . .	2	2	1	0	0	1	1	1	2	2	2
6. From surface (yellowish turbidity)	1	1	1	0	0	0	0	0	1	1	2	2

The result is much less marked—no iron shaving being present. But it was seen, in the case of both samples, that enough oxide of iron was present to yield a fairly deep blue colour after acidifying and adding potassium ferrocyanide. There is, as already stated, very little sulphate in the water; so that the oxide of iron may be assumed to exert some influence.

In order to test this further, flasks were made up with precipitated hydroxide of iron in increasing quantities, also with purifying material. But the results were abnormal—a greater quantity of hydroxide producing less pollution than a smaller.

Other tests were made by bubbling the gas through ordinary water in which some oxide of iron had been obtained in suspension by allowing iron turnings to remain in it for an hour and twenty-four hours respectively in the cold and for twenty-four hours at 60° C. The results with the test paper, on passing the gas were roughly: 2 3 3 3 4 3 3 2 2 2. Other tests (the details of which it is needless to give) showed that the maximum action on the gas was obtained when the iron turnings were well cleaned; and test flasks were prepared which gave the full No. 5 depth of the test paper simply by using turnings well cleaned with acid or even fresh from the lathe. In some (though rare) cases the sulphuretting action proceeded badly. This occurred perhaps once in ten times, and was possibly due to minute traces of grease preventing the action of the iron on the water. It was never experienced with turnings cleaned with acid.

Trials were then made by treating flasks which produced extreme pollution of the gas by additions of the customary metallic salts. Sulphate of iron appears to retard the sulphuretting effect, but only for a very short time. Sulphate of copper was not found to have any marked retarding action under the conditions of the experiment—using a proportion of 1 : 1000. The strength, 1 : 10,000 named by another investigator as effective also gave no positive result; and it would seem that copper sulphate cannot be a very active retarder inasmuch as it is converted immediately into iron sulphate on contact with the plates of the tank. Any chance effect would appear to be due to the deposition of a coherent film of copper on any bare part of the wrought iron, thus putting an end to sulphuration. These two sulphates are, therefore, not to be recommended.

Zinc sulphate, on the other hand, was found to exert a very pronounced action. At the strength of 1 : 1000, the sulphuretting action was almost instantly stopped, and did not set in again. The result of one experiment among others is:—

17. Ordinary water with iron turnings . . .	5	5	5	5			
1 : 1000 zinc sulphate added	0	0	0	0	0	0	0

Seeking the minimum strength of zinc sulphate which is effective, 1 : 4000 was found almost to arrest the action. This is about equal to 250 gms. to 1 cubic metre of water, and is about the quantity to commence with in practice when the sulphuretting action is not very marked. Metallic zinc, however (as will be seen later), is even better.

A test was made to see if the zinc sulphate acts of itself or if it forms some deposit on the iron turnings. A flask was made up as usual with ordinary water and iron turnings, and left for a week with the gas passing through it, in order to obtain active sulphuration. Zinc sulphate, 0·05 gm. (= 5 : 10,000) was then added. Sulphuration instantly stopped, and the flask ran for twenty-five days without giving any trace of the hydrogen sulphide on the test-paper. The water was then changed; that removed being found to contain zinc. It was replaced by ordinary water and the iron turnings well washed with ordinary water. On starting the gas again, the result was: 0 1 1 1 1 2 4 5 5 5 5 5. Sulphuration thus started again and reached a maximum in about the usual time—that is to say treatment with the zinc sulphate did not modify the sulphuretting action of the iron.

The foregoing experiments have shown that it is easy to convert pure gas into gas which will not stand the lead-paper test. This change is brought about by two connected actions differing in amount. One is catalytic; the other electrolytic. A proof of this latter and more important action is as follows. Three flasks were prepared with three iron turnings each cleaned with acid. One was used as a check test; in the second, the iron turnings were fitted with a cap of zinc; in the third, the cap was of copper—both simply pinched on to the turnings. Results:

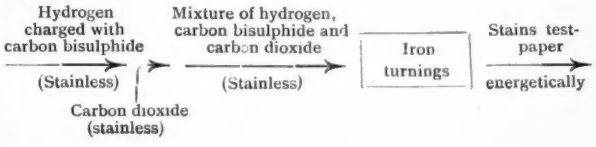
18. Check test	5	5	5	5	5	5	5	5	5	5
19. With zinc cap	0	0	0	0	0	0	0	0	0	0
20. With copper cap	5	5	5	5	5	5	5	5	5	5

It would seem that when the iron of the tank is bare, it forms an iron-carbon couple in which the iron is electro-negative; and this couple sulphurizes the gas which passes. When, by means of a zinc electrode, we make the iron of positive polarity, the sulphuration is no longer produced. Moreover, the appearance of the flasks is quite different. While that of No. 18 has a brownish sediment in turbid water at the end of the experiment, No. 19 remains clear, with scarcely any yellowish deposit.

Irregularities are experienced in the action of the zinc, suggesting its *rôle* being catalytic also. It would seem that when the sulphuretting action of the iron turnings is in full action, the zinc cap is powerless to stop it. The irregularity of action is connected with the greater or less perfection of contact between the iron and zinc. Zinc soldered to the iron turnings was found to stop sulphuration absolutely, while with the cap merely pinched on there was slight continuance of sulphuration under the same conditions. Sulphuration was never obtained with a soldered zinc cap, and when such a cap was soldered to iron turnings which were causing an intense sulphuration, the action of the latter was always instantly arrested.

The length of time over which sulphuration proceeds, as described in the previous experiments, bars any theory as to the source of the sulphur other than that it is the gas itself. In purified gas, sulphur is still present in the form of carbon bisulphide, also as thiocarbides, such as thiophene, thiotoluenes, thioxenes—these latter in small proportion. Experiments were, therefore, made in order to reproduce the sulphuration phenomena, starting with pure materials.

A current of pure hydrogen, made from zinc and sulphuric acid, and purified by bubbling through solutions of potassium permanganate, caustic soda, and lastly over fresh purifying material was passed over iron turnings (well cleaned in acid) immersed in water. The gas then passed to a receptacle of the lead paper, a similar test-paper chamber being placed in the stream of gas before it reached the iron turnings. The gas having passed for two days, the test-papers remained white. A vessel containing water and a few drops of carbon bisulphide was then interposed; and on the gas again passing (for three days) the test-papers still remained white. A current of pure carbon dioxide was then caused to mix with the hydrogen. It was ascertained that none of these components of the gaseous mixture singly darkened the test-paper. The mixture also at the inlet to the iron turnings did not affect the lead paper; but at the outlet it was turned completely brown in less than three minutes. The arrangement of the apparatus may be shown thus:—



The same experiment carried out without the carbon bisulphide yielded no trace of darkening, but sulphuration and darkening of the test-paper were instantly produced on introducing a drop of carbon bisulphide into the stream of gas. Also sulphided products are formed on the iron; for by cutting out the carbon bisulphide and continuing to pass the mixed gases, the paper continued to darken, though much less than before. And once the action has commenced, the carbon dioxide can be omitted—the hydrogen and carbon bisulphide continue to produce sulphuration though to a less degree. The electrolytic action of the iron-carbon couple is small in pure water but becomes pronounced as soon as there is an acid present in solution—in this case carbonic acid. The conductivity and ionization then reach an appreciable value and sulphuration begins. The production of hydrogen sulphide from the carbon bisulphide in presence of water follows the equation.

$$CS_2+2H_2O=CO_2+H_2S$$

As soon as the reaction has started, carbonic acid is constantly generated. Hence the continuance of the action when hydrogen and carbon bisulphide only are used.

It has been objected, perhaps somewhat prematurely, that the quantities of hydrogen sulphide thus produced by chemical means are so small that they do not correspond with the conditions of practice. As will be seen below, however, these quantities are comparable with the latter when the reaction is intensified by the presence of metallic iron, and in all cases are greater than those obtained through the agency of micro-organisms. In some English experiments, the blackening of test-papers by hydrogen sulphide (produced by alleged biological means) was a matter of from one to three months, while in the case of the chemical processes the same result was obtained in less than an hour.

In reference to the foregoing experiments, mention must also be made of the case recorded in the "JOURNAL OF GAS LIGHTING" [Vol. LXXXVII., p. 734], where gas drawn from a main supplying a gas-testing station in Tudor Street, London, was found to contain hydrogen sulphide, while that obtained on an upper storey of the same building was perfectly pure. The pipe leading to the testing-room contained a bend where water collected; and it was ascertained (or may we say, assumed) that this water contained the micro-organisms which caused the contamination of the gas. It is not clear how these micro-organisms got into the bend. Moreover, the water which condenses in gas-mains does not contain calcium sulphate convertible by the bacteria. If, on the other hand, it is suggested that in England branch pipes are usually of iron and that in the water collected in the bend a minute fraction of the metal surface was bared or even rusted sufficiently to give rise to sulphuration under conditions at least as good as the flasks with their iron turnings, even with these things postulated, there is still cause for uncertainty.

The proportion of hydrogen sulphide in the gas coming from the various "contaminated" flasks was determined with the Du Pasquier iodine solution. It ranged from 0·015 to 0·040 gm. of sulphur per cubic metre. An estimation made with ammoniacal silver nitrate solution gave 0·032 gm. of sulphur per cubic metre. Also two determinations made, at an interval of several days, on the contaminated gas from the gasholder gave similar figures—viz., 0·044 gm. and 0·012 gm. of sulphur per cubic metre. These show that the lead paper test for sulphur is much more sensitive than is generally supposed. The test-paper is certainly more delicate than 1 part in 300,000.

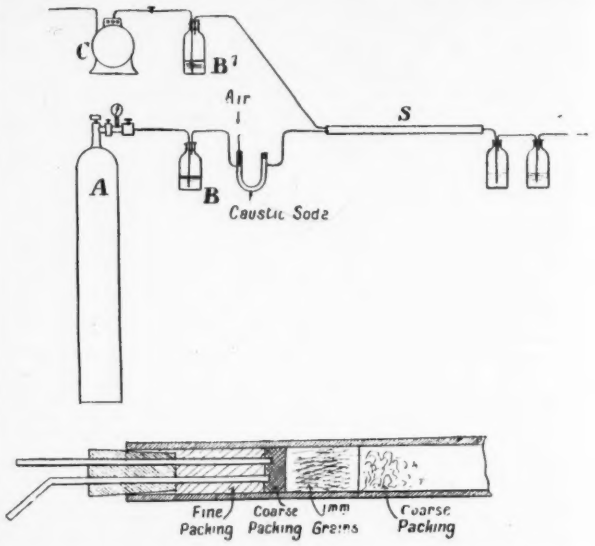
It will thus have been seen that the cause of pollution of gas in a holder is the exposure of a bare metallic surface as a result of oxide scales coming away. Sulphuration then appears almost inevitably, and increases in intensity. With rust in the holder, the result is aggravated by the catalytic action. Hence no holder is free from this complication; and an initial action on the wrought iron plates stands a good chance of becoming worse, and leading to much trouble.

The remedy, if the gasholder can be dispensed with for a time, is to empty it completely and to solder to the lower part of the holder some sheets of zinc—say, four each, of the dimensions of one of the iron plates. Two or three zinc sheets may likewise be soldered to the plates of the bottom of the tank.

If the holder cannot be put out of use, a trial can be made of placing a few zinc sheets, bent to an arch, in the tank while the holder is well up. These plates will rest on the bottom of the tank, making the contact with it which is the essence of the method. Likewise some zinc sheets may be introduced into the upper part of the holder, inserting them edgeways into the channel provided for a future section of the bell.

The proportion of the masses of the reacting substances being so different in the experimental flasks and in actual practice, it must not be expected that the results in the latter case will be immediate. A month may well elapse before an opinion is formed as to the effect of the zinc. If the result is not then satisfactory, recourse should be had to sulphate of zinc. This can readily be prepared from waste zinc and sulphuric acid, using an excess of zinc to the extent of from 10 to 15 per cent. An almost saturated solution of zinc sulphate can be prepared in this way, using 66 per cent. of sulphuric acid diluted with five times its volume of water. The solution so made is mixed as thoroughly as possible with the water in the tank. A start may be made with 250 gms. per cubic metre—more being added if this is not sufficient.

The pollution of the gas having been shown to arise from the sulphide contained in it, our next step was to investigate means for removing it. As a preliminary to this, we sought to devise an improved method of determining the proportion of carbon bisulphide. The methods of Dr. Drehschmidt and Dr. Hempel are too slow for purposes of frequent works' determinations, and the method now employed is as follows: The gas is burnt in air strongly enriched with oxygen, performing the combustion in a tube. The products consist, apart from sulphur compounds, of water vapour, carbon dioxide, a little nitrogen, and an excess of oxygen, and, when cooled, are less in volume than the original gas. The arrangement of the apparatus is shown in the drawing.



An oxygen cylinder A supplies a current of this gas which passes through a bottle B containing caustic soda solution, and allowing of an idea being formed of the rate of passage of the oxygen. The gas is then taken into the combustion tube S, of fused silica, by another tube (also of silica) of smaller diameter—a U-tube containing solid caustic soda being interposed. One limb of the U-tube communicates freely with the atmosphere. The gas to be tested is supplied through the meter C and a wash-bottle B¹. The silica tube S has an internal diameter of 16 mm., and a length of 1 metre. The two delivery tubes of coal gas and oxygen, both of silica, pass through a cork, and enter the large tube a few centimetres along. Having placed them in position, finely powdered quartz (passed through a sieve of 1 mm. mesh) is introduced up to the level of the ends of the tubes. This filling is succeeded by a layer of from 2 to 3 cm. of coarsely broken quartz or fragments of silica, of such a size that they will not get into the two gas-tubes. Above this coarse filling come 3 or 4 cm. of quartz passed through a sieve of 1·3 mm. mesh; and, lastly, to pack the whole firmly in place, there are about 10 cm. of coarsely broken quartz. The outlet end of the tube is connected by a cork and tube to two absorption flasks, and thence to an aspirator. In the flasks is placed any suitable volume of exactly neutralized hydrogen peroxide. The tube S is slightly inclined towards the flasks.

Things having been arranged as described, a burner is placed under the sieved quartz of the 1·3 mm. coarseness. The tube being made red hot at this point, the aspirator is started and the oxygen turned on. The gas is then gradually turned on and ignited in the coarse packing in the tube—intensely heating the latter. Partial combustion is produced in this portion, and much heat is given off. The partly burnt gases traverse the 1-mm. grains of quartz, mix there, and complete their combustion in the outside zone—part in the grains and part in the last packing. It is well to leave the burner in place, in order to ensure the combustion being complete. It is then seen that the aspiration is properly adjusted by bringing up a small spirit flame to the inlet of the U-tube. Air should be lightly drawn through this tube, as it prevents any reduction of pressure being produced in the silica tube and keeps the combustion regular. The supplies of gas and oxygen are adjusted—taking care to see that there is an excess of oxygen; and when this is done it is easy to burn 2 litres of gas per minute in such a tube. I have complete combustion of 50 litres within 20 minutes, while the time of a good combustion need not exceed 30 to 35 minutes.

The products of combustion, as a rule, are almost sufficiently cooled by their passage through the rest of the tube. A strip of filter paper, about 30 cm. in length, laid on the tube and kept damp, suffices to cool the gases completely. If a little methyl orange is used to colour the hydrogen peroxide solution, as soon as the combustion begins, the contents of the first flask turn red in consequence of the acid substances formed. All these latter are retained by the first flask; I have never seen the solution redden in the second. In the first flask are placed 20 cc. of twelve-volume hydrogen peroxide (neutralized), diluted with 50 cc. of ordinary water. This retains and oxidizes the whole of the products of 50 litres of gas.

At the conclusion of the combustion, the flasks are disconnected from the silica tube, and any drops of water which have collected

behind the cork at the outlet end are added to the liquid in the first absorption flask. The whole contents of the latter are then titrated with a standard alkali solution, using methyl orange as indicator.

There is no reason to fear the formation of nitric acid in the silica tube as a result of the high temperature. This has been confirmed in the case of numerous combustions, by checking the volumetric estimation of the sulphuric acid, by precipitating the sulphate as barium sulphate and weighing it. The results by the method have likewise been checked by the Drehschmidt method with very close agreement.

Turning now to the removal of the carbon bisulphide from the gas, we have already seen that the bisulphide in presence of water vapour is converted into hydrogen sulphide and carbon dioxide. This reaction, which scarcely takes place at all at the ordinary temperature and if metallic iron is not present, becomes marked when the temperature is higher, and still more so in the presence of some substance which removes the hydrogen sulphide as fast as it is formed. The method suggested, therefore, for the removal of the carbon bisulphide from the gas is to pass the latter (heated and after the usual purification) into a purifier box containing oxide of iron and itself heated. To reproduce this process under experimental conditions, a small purifier of 10 cm. diameter, containing oxide of iron to the depth of 30 cm., was heated in an oil bath, and the gas passed through it. The following were the results obtained for the total sulphur in the samples of gas before treatment in this way—given in grammes per 100 cubic metres:—

Loire coals . . .	36·84	30·30	30·04	36·89	36·56
English coals . . .	63·34	63·34	41·46	47·67	47·34	52·56

The mean of the whole series is 44·21.

After passage through the hot purifier, the results with these gases were as follows:—

9·30	9·14	7·34	8·81	8·97	10·88	Mean	9·63
10·30	9 79	11·75	10·77	9·79	8·81		

Owing to the water in the meter absorbing a part of the sulphide of carbon, these results are only approximate. In order to obtain a correct estimation of the purifying effect, it would be necessary to arrange two identical combustion chambers, working together, one with ordinary gas and the other with the same gas after passage through the hot purifier. In default of doing this, I arranged the inlet of the gas in duplicate, so as to have one meter constantly traversed by a current of ordinary gas and another by the gas from the hot purifier. By making two successive combustions, I obtained two figures at an interval of one hour. It may be assumed that the results under these conditions (which are as follows) will reasonably represent the facts:—

Coal.	Sulphur in Ordinary Gas. Gm.	Sulphur in Gas at Outlet of Heated Purifier. Gm.
Loire et Puy-de-Dôme	21·54	7·50
	24·16	6·85
	21·54	7·14
Puy-de-Dôme	28 97	11·42
	29 06	10·77
	31 67	10·61
	31 67	9·46
	31·67	9·63
Puy-de-Dôme, ¾; English, ¼	38 81	9·63
Loire, ⅓; English, ⅔	36 90	10 77
	36·90	11·10
	31·34	10·44
	38·52	9·79
	40·81	11·91
	46·11	8·49
	46·11	8 57
English	50·79	13·22
	55·50	13·22
	54·52	9 79
Mean		9·85

As shown by the table, the quantity of sulphur is greatly reduced. The part which thus resists the action of hot oxide of iron is due to thiocarbide. Gas thus purified gives no reaction with etherial solution of tri-ethylphosphine, showing that the carbon bisulphide is entirely removed. The odour of the gas is completely changed. It loses its usual sharp smell, and more nearly recalls the odour of benzol.

In carrying out the ordinary purification of gas, tests have shown that the carbon bisulphide is removed in greater proportion as the temperature is higher and the time of contact longer. It may be said that the absorbing power of the iron oxide on bisulphide is not marked below 25°, but that above that temperature the quantity of carbon bisulphide is considerably reduced. Thus the heating of the purifier boxes is of chief importance in winter, and calculations show that the quantity of steam heat for the purpose is not excessive. As the gas at the outlet from the heated purifier is found at times to darken the lead test-paper, the position of the purifier box should be in front of the safety boxes. If this is not feasible, a further small purifier would be used to take up traces of hydrogen sulphide.

Lastly reference must be made to the effect of carburation in increasing the quantity of carbon bisulphide in the gas. Benzol is described by various authorities as containing 5 to 0·2 per cent. of carbon bisulphide—from 1·0 to 0·2 per cent. in the rectified samples. Benzol also contains about 0·5 per cent. of thiophene. My own determinations of the sulphur in benzol have confirmed these figures. They give from 0·901 to 0·255 of total sulphur. In view of the quantity of benzol employed in carburetting—say, 10 gms. per cubic metre—it is easy to see that the content of sulphur may in this way be raised from 10 to 20 gms. per 100 cubic metres.

In conclusion, no figures are available as to the rate at which gas should be passed through the heated purifier; and it should be made clear that the figures which have been quoted are the result of laboratory experiments, and very possibly may prove different in practice. I have, however, sought to render the conditions of the experiments as nearly as possible those prevailing in actual manufacture. The trial of the method on the industrial scale will, it is hoped, allow of the present communication being given a more complete form.

REGISTER OF PATENTS.

Vertical Retorts.

DUCKHAM, A. M'D., of Little Bookham, Surrey.

No. 1347; Jan. 17, 1912.

In his specification the patentee points out that, in order to facilitate the discharge of coke from retorts for the carbonization of coal which have been more or less completely filled with coal, the retorts have been made uniformly taper—that is to say, the axes of the retort have been made longer in the same proportion from one end of the retort to the other. In continuously working retorts, wherein the coal enters the top of the retort, is carbonized during its passage through the retort, and is discharged from the bottom of the retort, different physical conditions prevail at different zones of the retort. When it enters the retort, the coal becomes softened and sticky, and swells; so that skin-friction between the charge and the retort is greatest at this part. As the coal becomes coke, the swelling diminishes until at the bottom of the retort the charge actually shrinks. A uniform taper takes no account of these changes.

According to his present invention, continuously operated vertical retorts are constructed with a taper of wider angle at the top portion than at the bottom, and preferably with a taper of successively narrower angle in successive zones from the top to the bottom of the retort.

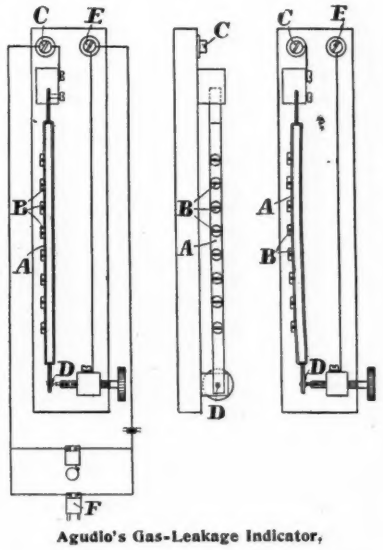
So far, he says, it has been found essential that vertical retorts should be made with one axis shorter than the other; the limits of the minor axis being determined by the facts (1) that at the top this axis cannot be shorter than will readily allow passage of material, and (2) that at the bottom it cannot be longer than is compatible with ready penetration of heat to the middle of the charge, which, of course, is the last portion to carbonize. In retorts constructed according to the present invention, it is preferable to maintain the same ratio of the minor axis, which is, of course, the width when the cross section is rectangular at the top to that at the bottom, as has been the custom when the taper has been uniform, and to increase the intermediate minor axes as compared with those when the taper was uniform. For example, in a retort 25 feet high, the minor axis at the top may be (say) 8 inches; at a height of 20 feet, 12 inches; at a height of 15 feet, 15½ inches; at a height of 10 feet, 18½ inches; and at the bottom, 20 inches.

Detector for Gas Leakages.

AGUDIO, R. E., of Turin.

No. 12,910; May 29, 1911.

This gas-leakage detector is of the type adapted to work in combination with an electrical bell for giving warning of the leakage or closing the gas supply pipe.



Agudio's Gas-Leakage Indicator.

As shown in front and side elevation in inactive position, and in front elevation in active position, this essential member of the device comprises two strips or wires of the same metal (one having a very high

co-efficient of expansion) held together at the ends only; the limbs being either straight or curved, parallel or not, and separated from each other by a layer of air. One strip is provided with mountings of a material capable of rapidly absorbing the gas the presence of which is to be detected—"this absorption developing great heat in the material." In the case of hydrocarbons, spongy platinum may be utilized. The material may be arranged about the limb A in the form of a layer or small separate plates or lozenges B. The member is attached at the upper ends to a fixed metal block electrically connected through a wire with a binding screw C. The lower end is free and provided with a contact D, in front of which, and on the side away from the lozenges, is arranged a micrometer screw having a contact point adjusted just clear of the contact D—the screw working in an internal thread in a metallic block electrically connected with a binding screw E.

When a gas capable of being absorbed by the lozenges B with development of heat diffuses into the surrounding air, the limb A becomes heated and expands, while the other limb, being separate, does not heat up and so retains its initial length. The member therefore becomes bent as shown in the third arrangement, so that contact is established at the point D. The making of this contact is utilized to detect the presence of the gas by making the binding screws C E the terminals of an electric circuit containing in series a battery and bell which will sound when there is danger. The detector may be used in combination with a device F, which closes the gas supply pipe and is also connected in the same circuit and in parallel with the bell, when used. Directly the action of the gas on the lozenges B ceases, the member A reassumes its initial position. The detector is said to have the very important feature of being unaffected by changes of temperature in the surrounding air, and only operates when a difference of temperature between the two limbs is established. Any change in the surrounding temperature produces equal linear expansion of the two limbs, since these are of the same metal, and, consequently, an expansion of the whole member, which cannot cause a closing of the contacts however small the distance between these two points may be adjusted, with the object of giving maximum sensitiveness. On the other hand, the slightest increase in temperature of the limb A above the other limb, owing to the independence of the limb, causes the operation of the device as described.

Retort-Furnaces.

STETTINER CHAMOTTE-FABRIK ACTIEN-GESELLSCHAFT, vormals DIDIER, of Stettin, Germany.

No. 1608; Jan. 20, 1912. Date claimed under International Convention, Sept. 11, 1911.

This invention, relating to retort-furnaces having regenerators and recuperators, is particularly adapted for use with a gas of a low grade and poor in hydrocarbons.

As is well known, the patentees remark, the preliminary heating of the combustion air for the heating gas in retort-furnaces is preferably effected by means of regenerators through which the waste gases and the combustion air are caused to pass alternately. A portion of the gas generated in the furnace has preferably hitherto been used as a heating gas; but if the furnace is situated near (for instance) to a blast-furnace or to a producer-gas plant, it is frequently advisable to utilize all the gas evolved in the retorts for lighting or power purposes, and to employ for the purpose of heating the furnace the cheaper gas generated from inferior fuel in a blast-furnace or producer. As these gases are poor in hydrocarbons, to render them suitable for use as heating gases, they must be heated before being introduced into the heating walls of the retort-chambers—the increased temperature depending on their nature.

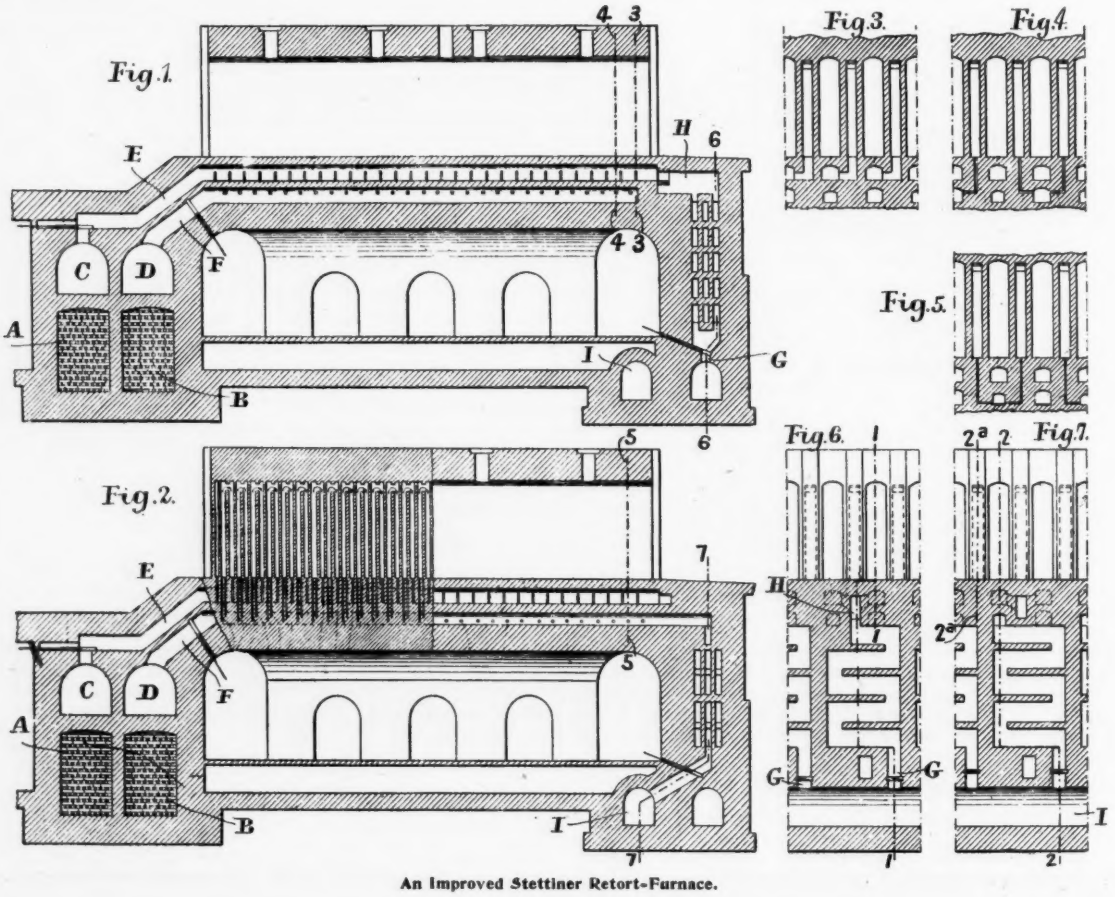
In a retort-furnace according to this invention, the poor heating gas is given a preliminary heating by means of recuperators provided with separate conduits, through which the waste gases always pass, and further separate conduits through which the heating gases always flow—these conduits being divided from one another by heat-exchange walls by means of which the waste gases impart a preliminary heating to the heating gas. The invention consists "in such a relative arrangement of the regenerators used for preliminary heating of the combustion air, and of the recuperators for the preliminary heating of the heating gas, that the proportion of waste gases flowing through the recuperator can be regulated merely by means of throttling members formed in the discharge conduits for the waste gases—regulation being effected in accordance with the nature of the heating gas and in such a manner that all the heat of the waste gases is always utilized. This is obtained by connecting the conduits of the recuperators through which the waste gases flow to other conduits by which the waste gases are led to the regenerators. By so connecting the recuperators employed to utilize the heat of the waste gases, only the throttling members provided in the waste-gas outlet conduits of the recuperators need be correspondingly shifted to ensure a sufficient preliminary heating of the poor heating gas, in case of variations in its nature. Any heat of the waste gases not required at the time by the recuperators is then always utilized in the regenerators for the preliminary heating of the combustion air."

If a retort-furnace having regenerators connected at one end of the furnace to the hearth-conduits for the combustion air and the waste gases is provided with the throttling apparatus according to this invention, a very compact furnace is said to be obtained by arranging the recuperators at the other end of the furnace and connecting the conduits through which the waste gas is conveyed by means of transverse passages to the ends of two adjoining waste-gas hearth-conduits. The conduits used for supplying the heating gas coming from the recuperators to the heating walls of the retorts are then preferably formed as separate hearth-conduits arranged under the hearth-conduits for the waste-gases and between the hearth-conduits for the combustion air." Any tendency for the heating gas which has thus been heated to become cooled again during its passage from the recuperators into the heating walls of the retorts is thus entirely prevented.

In the construction illustrated, by way of example, the furnace is a horizontal retort-furnace with the direction of the flames constant.

Fig. 1 shows the furnace in vertical longitudinal section taken through the centre of a retort-chamber on the line 1 of fig. 6. Fig. 2 is a vertical longitudinal section on the line 2 of fig. 7, partly in section on the line 2a. Figs. 3 and 4 are vertical cross sections on the lines 3 and 4 of fig. 1. Figs. 5, 6, and 7 are cross sections on the lines 5, 6, 7 of figs. 1 and 2.

The furnace comprises adjoining retort-chambers, the partitions



An Improved Stettiner Retort-Furnace.

between which are provided with heating flues divided by partitions into rising heating flues and descending heating flues. Into the former flues open vertical branch conduits for supplying the heating gas, as well as branch conduits for supplying the combustion air (figs. 4 and 5); while to the descending heating flues are connected branch conduits for discharging the waste gases (fig. 3).

At one end of the furnace are arranged, for the preliminary heating of the combustion air, regenerators A B which can be connected at will either with the atmospheric air or the chimney, and (by means of a slide valve) to the preliminary chambers C D. To enable the regenerators to be connected to the preliminary chambers, slides are formed in the conduits which establish communication between each chamber and the regenerators. Communicating with the chamber C is a conduit E, the cross-sectional area of which can be regulated by a slide valve leading to a hearth-conduit arranged in the longitudinal direction of the corresponding retort-chamber immediately under the sole of the chamber. The waste gases constantly pass through the conduit, and the branch conduits open into it. The other chamber D is connected by a conduit F to a conduit provided under the other hearth-conduit of alternate retorts—combustion air always passing through the lower conduit. Into it open the branch conduits of each two adjoining heating walls of the retort-chambers.

At the other end of the furnace are arranged recuperators in which the heating gas is subjected to preliminary heating by the waste gases. Each recuperator consists of three zig-zag conduits separated from each other by partitions. The two outer conduits are connected at their lower ends by a conduit G, the cross-sectional area of which can be regulated by a slide valve to the smoke flue, while their upper ends open into a common conduit H connected at the end of the retort, by means of transverse conduits, to the ends of two adjoining hearth conduits. The central zig-zag conduit of the recuperator is connected at its lower end to the heating gas supply conduit—say, to a conduit I for the supply of gas from a blast-furnace. It opens at its upper end into a conduit extending to the other end of the retort-chamber.

The combustion air passes in a heated state from the regenerators B at the left of the furnace into the rising heating flues, together with the blast-furnace gas, which becomes heated by flowing through the conduits of the recuperators, passes at the right-hand end of the furnace in a heated state into the hearth-conduits, and escapes from the latter through branch conduits into the rising heating conduits of the heating walls. A portion of the waste gases passing from the descending heating flues is directed towards the left-hand end of the furnace, where it passes through the conduits E and the chambers C into the regenerator A, and escapes from the latter into the chimney. Another portion flows towards the right-hand end of the furnace, where it passes through the conduits H and the outer conduits of the recuperators, into the smoke flue. During this time, a portion of the waste gases gives off its heat to the regenerators A, while the other portion, passing through the recuperators in a direction opposite to that of the blast-furnace gas, exchanges heat with the blast-furnace gas in these recuperators.

If the proportion of hydrocarbons in the heating gas passing through the conduits I, for instance, decreases, owing to a still poorer blast-furnace or producer gas being used, the slide valves are merely opened wider. A greater quantity of waste gas then passes through the recuperators, so that the heating gas, in passing through the conduits, is more strongly heated. If for any reason the proportion of hydrocarbons in the heating gas increases again, the slide valve is closed to such an extent that the heating gas just reaches the temperature required for its ignition. The heat of the difference between the original quantity of waste gas and that then passing through the recuperators is directly utilized for heating the combustion air, as the quantity in question is forced to pass through the regenerators, through which the combustion air is led after changing over the regenerators.

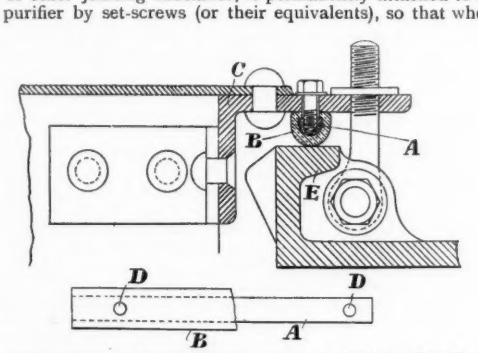
Owing to the recuperators being right at the end of the furnace which is not occupied by the regenerators A B, the construction of the retort-furnace is said to be "very compact," and the waste heat of the furnace is utilized in an extremely advantageous manner for imparting preliminary heat to the heating gas, owing to the absence of long connecting conduits.

Joint for the Lids of Gas Purifiers.

SADLER, H. S., and ASHMORE, BENSON, PEASE, AND CO., LIMITED, of Stockton-on-Tees.

No. 28,916; Dec. 22, 1911.

According to this invention, a steel core, with a wrapping of india-rubber or other jointing substance, is permanently attached to the lid of the purifier by set-screws (or their equivalents), so that when the cover is pressed down a perfect gas-tight joint is obtained—"the steel core being of sufficient thickness and area in cross section for the set-screws to be screwed into it, and to be rigid enough to extend the effect of dislocating strains during lifting along the length of the joint, and consequently over a series of set-screws, instead of being localized perhaps as an overstrain to one or two bolts and the adjoining strip of the joint."



Sadler and Ashmore, Benson, Pease, and Co.'s Joint for Gas-Purifiers.

The illustration shows a part section through the top of a purifier and its cover with the double joint applied to it; also a plan of the rubber and steel core.

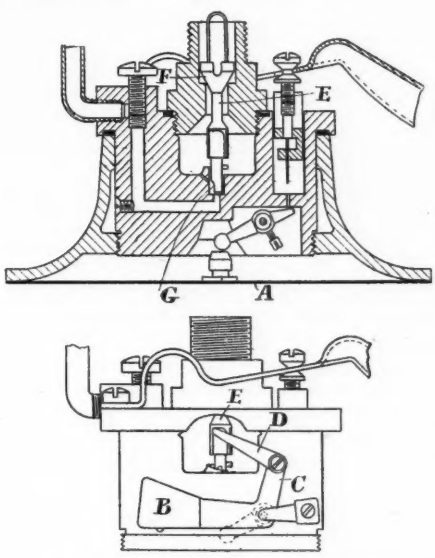
A is a bar of steel (preferably semi-circular in shape) on which is mounted a wrapping of rubber jointing substance, in the form of strips B, permanently attached to the cover C by set-screws D or their equivalents. These rubber strips fit between the underside of the cover and the flange E of the tank, against which they are forced in order to form a perfectly gas-tight joint Or the rubber may be attached to the flange. There is thus no metal-to-metal contact, but a rubber-to-metal contact throughout. The object of the steel core is to provide a rigid connection of the rubber joint to the lid, and also to apply an equal pressure throughout its entire length. The upper part of the rubber strip is flat, so as to form a suitable bearing surface to the underside of the lid.

Lighting and Extinguishing Gas-Lights from a Distance.

AKTIEBOLAGET LUX, of Stockholm.

No. 1285; Jan. 16, 1912. Date claimed under International Convention, Jan. 17, 1911.

This invention relates particularly to apparatus in which a valve obtains its motive power from a diaphragm actuated by variations of pressure in the gas-conduit in such manner that the main jet and the pilot jet can be alternately lit and extinguished.



A Swedish Lamp Lighter and Extinguisher.

The diaphragm A is actuated by the variations of pressure in the gas-main, either directly or by means of the air cushion described in patent No. 11,371 of 1909. When the pressure is increased, the diaphragm bellies upwards, lifting the weight B and turning the angle lever C to the right until the lever D comes in contact with one of several grooves on the valve E. When the diaphragm returns to the normal position, the weight is lowered and turns the levers to the left, whereby the lever D is forced upwards in the groove, finally leaning against the top end of it and lifting and turning the valve so that the valve F is opened while the valve G is shut. The lifting of the valve is regulated by an inclined guide on which a lug slides when the valve is turned. By another movement of the diaphragm the valve E is turned further in the same direction; thus causing the lug to pass the highest point of the guide and cause the valve E to return to the position shown in the section.

With this arrangement, it is possible to get any required suitable interval between lighting and extinguishing or between extinguishing and lighting of the main and pilot jet of a street-lamp by changing the pressure in the gas-conduit so that at the first compression of the gas the valve is lifted and turned by the levers, lighting the main jet, and extinguishing the pilot jet; while at the second compression, the valve is only turned and prevented from falling by the horizontal part of the guide. After this second compression, the flames are unchanged. At the third compression, the valve is again turned until the notch passes the end of the guide curves and the valve falls by gravity, or is forced down by a spring—thus extinguishing the main jet and lighting the pilot jet.

APPLICATIONS FOR LETTERS PATENT.

13,596.—DALÉN, G., "Storing acetylene gas." June 10.

13,647.—TURNER, C. J., "Notifying users of prepayment meters that the supply is about to be discontinued." June 11.

13,667.—EVERETT, S., "Distillation of coal, &c." June 11.

13,674.—BRIDGER, J., "Mantle-rings." June 11.

13,856.—GOBIET, L., "Support for mantles." June 13.

13,954.—SMITH, H. C., "Gas-burners." June 15.

13,998.—ARMITAGE, W. K. L., and LUCAS, J. S., "Attaching mantles." June 15.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Alliance and Dublin Consumers' Gas Company.

SIR,—The attention of the Directors of the Alliance and Dublin Consumers' Gas Company has been called to the anonymous letters which have appeared in the "JOURNAL" with respect to the depreciation of the shares of the Company; and, while anxious to afford shareholders every information, they do not feel called upon to enter into a discussion in the columns of the "JOURNAL." At the same time, any communication addressed to the Secretary and Manager from a shareholder will receive the immediate attention of the Board; and the whole subject will be dealt with by the Directors in due course.

Dublin, June 22, 1912. FRANCIS T. COTTON.

SIR,—It is quite obvious that the Directors resolutely decline to offer to the stockholders and the general public any explanation or comfort regarding the very unsatisfactory state of the Company's position on the Stock Exchange, or else they quite fail to properly appreciate the seriousness of the question.

In recent years the Company have appealed to British investors to subscribe new capital; and, if I am not mistaken, it will be necessary very shortly to do so again. Therefore, I say the Directors either shut their eyes to the circumstances, or fail to appreciate matters. Whichever way, it is distinctly unsatisfactory to the stockholders. To continue the criticism is not difficult; but it must unfavourably impress the general public that there is unrest and dissatisfaction among the proprietors, and that the Directors stubbornly decline to come forward and defend the interests of which they are the guardians.

That radical steps are necessary to deal with a Company whose policy is retrogressive, cannot be doubted or denied; for, as pointed out in my last letter, the capital ratio for 1911 is much higher than it was in 1899, and this point is of material importance to all undertakings, as may be gathered from the following extract which I have before me from the sale particulars of well-known auctioneers, respecting some ordinary stock of a Suburban Gas Company:

> "Of all the Metropolitan or Suburban Gas Companies the capital outlay of this Company is the lowest or most economical—being no greater than 6s. 9d. per 1000 cubic feet of gas sold. The average of the London Companies is 10s. 7d., and of the Suburban Companies 9s., per 1000 cubic feet of gas sold."

This justifies the point I have made in previous correspondence; and I would ask your readers to compare this statement with the figures contained in my last letter with respect to the capital ratio of the Dublin Company.

In the case of the Suburban Company quoted, What does it mean? That the ordinary shareholders were in receipt of £8 7s. 6d. per cent. on their 5 per cent. standard stock, against 7½ per cent. in 1902-03, instead of only 5 per cent. in the case of Dublin. The comparison may be suggested as not reasonable; but I submit that it fully demonstrates what good management can achieve, whereas the opposite may be suggested for Dublin.

To give further effect to this point, I might say that in 1899 the Dublin Company earned 8·7 per cent. on their capital, as against 6·97 per cent. in 1911. The earnings in 1899 were sufficient (within a second place of decimals per 1000 cubic feet of gas sold) to meet all interest and full sliding-scale dividend charges; whereas in 1911 we find it nearly £8500 short—equal to 1·5d. per 1000 cubic feet of gas sold. In other words, in 1899, after providing for interest and 5 per cent. dividend, there was a surplus of £9876, as against, in 1911, after providing for interest and 5 per cent. dividend a deficiency of £2679—a difference between the two periods of no less than £12,555. This result is after obtaining from Parliament a very substantial reduction in the Company's standard illuminating power—namely, from 16-candle power on the flat-flame burner to 14-candle power on the No. 2 "Metropolitan" argand burner.

The price charged in 1899 was 3s. 5d., and in 1911 3s. 4d.—a drop of only 1d. per 1000 cubic feet. Those in the gas industry who can fully appreciate the true significance of these figures will not blame me for promising to continue my criticisms in a more emphatic manner; for the Board of a Gas Company who cannot make better progress than this requires a thorough overhauling by its stockholders.

June 21, 1912. NONULUS.

The Incidence of the Day-Load Factor.

SIR,—In replying to the discussion on my paper, upon the above subject, at the recent meeting of the Institution of Gas Engineers, I omitted one point I wished to make.

When I first decided to look into this question, I was baffled by my carbonizing book, which only recorded particulars of makes and stocks of gas at 9 a.m. I, therefore, introduced a new carbonizing book on Jan. 1, 1910, giving these details at 6 a.m. and 6 p.m. Upon bringing the matter before the Yorkshire Commercial Section, I found that hardly a single engineer kept records at 6 a.m. and 6 p.m., and the members very kindly agreed to commence keeping these records, so as to be able to give me the information I required, and these are embodied in my recent paper.

I found our day load during the first five months of 1910 averaged 31·80 per cent.; during the first five months of 1911, it had increased to 33·43 per cent.—an increase of 1·63 per cent.; and during the first five months of 1912 it had further increased to 34·45 per cent.—an increase of 1·02 per cent., or an increase of 2·65 per cent. during the two years.

I attribute these increases to the fact that, in this new carbonizing book, the day load is worked out every week, and last year's corresponding day load is brought forward for comparison with it. This keeps the matter continually before one's eyes, and leads to constant efforts to improve it; so that I venture to recommend the practice to my brother engineers, as I have found the benefit in my own case.

Our day load is naturally low, as we are in a colliery district; but if we can go on increasing it at the rate of over 1 per cent. per annum, it will certainly be very advantageous.

Wakefield, June 22, 1912. H. TOWNSEND.

The Examinations Papers at the Institution Meeting.

SIR,—Please allow me to correct an excusable error which crept into your report of my remark at the Institution meeting last week.

In my reference to the humours of the examination papers the word "cowl" has been substituted for "cow." The addition of the final consonant quite destroys the point of the remark. The sentence should read "the best way of stopping a down-draught is to fasten a cow on the top of the chimney. I think you will agree with me," &c.

Now that I am writing, I should like to add, what I had not time to refer to at the meeting, that I am in perfect agreement with the other speakers who advocated the necessity of scientific knowledge. If a preliminary examination in gas-fitting were instituted, then candidates in the ordinary grade in "Gas Supply" should have previously obtained an elementary pass in the Science and Art Examination in two of the following subjects: Chemistry, Physics, or Mathematics; and candidates for the honours certificate in "Gas Supply" should have previously obtained a pass in either Advanced Chemistry or Physics or Stage 2 in Mathematics.

Leeds, June 20, 1912. WALTER HOLE.

Cooking by Gas.

SIR,—I am not a gasmaker, but I claim to know something about the distribution of gas for cooking purposes. Perhaps the following facts will interest the "progressive gas engineer."

I have carefully read the various papers presented to the meeting of the Institution of Gas Engineers, and also the statement that local circumstances affect matters very much. I particularly refer to the remark by the Gas Engineer of the Burnley Corporation, who said, though they had a comparatively high load, this was not due to advertising. In this he is entirely wrong. I will put him in possession of some facts. Now, if these wonderful gas-cookers were of such a character that they gave satisfaction to those who were obliged to purchase them or go without (the Burnley conditions for best-grade cookers), why have over 3000 patent gas-oven heat-distributors already been sold in the town during the past 2½ years—direct to the consumers by canvassers? Neither the Burnley nor any other gas engineer in the country can show that a gas-stove by its work, and the way it has been used in the past, can or does give the satisfaction to the user it ought to do.

Here is an easy way to get at facts. If the Burnley Gas Engineer feels that he knows anything about the practical side of using a gas-stove, I shall be delighted to meet him, or any man or woman he can find—the gas-stove makers included, and the paper-bag or the electrical cooking experts. If I fail to turn out of a gas-stove better roasted, baked, boiled, or stewed food at less cost in gas, and a cleaner oven when finished, with the aid of the heat distributor and method I teach, I will give £20 to any charity in the town they care to name where the work is done.

A gas company can give a stove and fix it free. Will it pay, if it is not used for cooking? That is my point.

Southport, June 20, 1912. R. GAMBLE MARKS.

"Pyrites Cinder" for Gas Purification.

SIR,—I noticed the above heading in your issue of May 28, p. 593. We have been working along these lines for some seventeen months—without success.

Quite by accident, last week I discovered a system of using "cinders," so as to get results in purifying gas such as have never before been obtained with any material!

Our regular material is a hydrated iron oxide; and it has given good results. But the cinders when used in the way I have discovered, can "beat iron sponge or bog ore to a frazzle." In a month from now we will have some interesting figures from practical tests.

I am in the business of preparing gas purifying material, so, of course, would not feel at liberty to disclose the secret of how to treat pyrites cinders and make an oxide of iron compound containing about 90 per cent. Fe_2O_3. The process costs, on a basis of 30 lbs. of oxide to a bushel of shavings, 2 c. (= 1d.) a mixed bushel of purifying material, above the cost of shavings and iron oxide.

Nashville, Tenn., U.S.A., June 8, 1912. A. S. B. LITTLE.

Public Lighting of Heywood.—From the annual report of Mr. Gee, the Lighting Superintendent to the Heywood Corporation, it appears that there are now in the streets of the borough 980 lamps, 21 of which are for electricity, the rest being for gas. The amount of gas used for public lighting during the past year was 4,452,157 cubic feet, and the cost £450 19s. The cost of electricity for the 21 lamps in use was £60 7s. The large lamps were lit 2371½ hours, the small ones 1746½ hours; the consumption being: No. 2 incandescent burners, 2·36 cubic feet per hour; No. 3 incandescent burners, 3·28 cubic feet; No. 4 incandescent burners, 4·15 cubic feet—this being the same consumption per burner as in the preceding year. For the year ended April, 1911, the figures were; Gas used, 4,765,301 cubic feet; cost of gas, £655 4s.; cost of electricity, £49 14s.; large lamps lit, 2490 hours and small lamps, 1804 hours. During the past year, a reduction of 9d. per 1000 cubic feet was made in the price of gas for public lighting, representing £170, which explains the difference in the cost of lighting in the two years. The number of mantles used was 6·25 per burner per annum, compared with 6·50 for the year ending April, 1911.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

The following progress was made with Private Bills last week :—

Read a second time and committed: Fylde Water Board Bill; Ivybridge Urban District Water Bill.

Bills reported: Annfield Plain and District Gas Bill; Belfast Water Bill; Bordon and District Gas Bill.

The Fleetwood Gas Bill and the Ashbourne Urban District Council (Gas) Bill were referred to a Select Committee consisting of the Duke of Bedford, Marquis of Camden, Marquis of Zetland, Viscount Falmouth, and Lord Silchester; to meet this day (Tuesday).

A petition against the Tipperary Gas Order, included in the Gas Orders Confirmation (No. 2) Bill, was presented by the Tipperary Urban District Council; and two petitions against the East Surrey Water Order, in the Water Orders Confirmation Bill, were presented from the Croydon Rural District Council and the River Wandle Protection Association.

The Alkali Manufacturers' Association have presented petitions against the Gas and Water Provisional Orders Bill in respect of the Swansea Gas Order and the West Kent Gas Order; and the Croydon Corporation a petition against the East Surrey Water Order contained in the Water Orders Confirmation Bill.

HOUSE OF COMMONS.

The following progress was made last week with Private Bills :—

Bills read a second time and committed: Bawtry and District Gas Bill (Lords).

Lords Bills reported: Brighton and Hove General Gas Bill; Brodsworth and District Gas Bill; Derwent Valley Water Bill; Lea Bridge District Gas Bill; Maidenhead Gas Bill; North Middlesex Gas Bill; Southgate and District Gas Bill.

Bill read the third time and passed: Local Government Provisional Orders (Gas) Bill.

A petition against the Woking District Gas Bill (Lords) has been presented by the London and South-Western Railway Company.

The petitions have been withdrawn of the Surrey County Council and the Epsom Rural District Council, against the Wandsworth, Wimbledon, and Epsom Gas Bill (Lords). The Bill being now unopposed, it has been removed from Group G, and referred to the Committee on Unopposed Bills, who will consider it on Thursday.

The petition of the Southampton County Council against the Christchurch Gas Bill (Lords) has been withdrawn.

Lighting of the House.

Sir DANIEL F. GODDARD gave notice last Wednesday that he will to-day (Tuesday) ask the representative in the House of the First Commissioner of Works whether the possibility has been considered of substituting a modern system of gas lighting for the illumination of the House, which, while increasing the illumination, would greatly reduce the present cost and be far more economical than electricity; whether the present system has been in use for at least forty years and is now obsolete; and whether the experiments reported to have been made were experiments with electricity only and not with gas under the improved conditions of modern lighting.

Dealing with the same subject, a correspondent of the "Pall Mall Gazette" last Thursday protested against what he described as yet another instance of unnecessary expense on the part of our "economical Government." He wrote: It is highly desirable that the fullest light should be applied to the doings of our legislators; but the ever-rising taxation demands that the illumination should be secured at the lowest cost consistent with the highest efficiency. I believe that the existing illumination is obtained from gas-jets of antiquated pattern, giving perhaps 2½ candles per foot of gas consumed, and that the burners are situated above a glass screen, in order to obviate the discharge of products into the chamber. The effect is fairly good; but the actual light obtained may be deficient. In this case, why not supersede the long-obsolete burners by the latest "inverted" incandescent gas, or even similar burners on the "high-pressure" system (as exemplified in Victoria Street, Westminster, and innumerable other localities in London and throughout the country)? To light the House of Commons means a heavy annual cost, whatever the illuminant employed. But gas is installed; and the additional capital cost for improved burners could not be more than a fraction of that necessary if an entirely new system be adopted.

Alluding to this letter, Mr. W. Higgins Jacob, writing from the Constitutional Club, pointed out that the cost of the installation of electric light in place of gas would be very great, the annual cost would be great, and the light inferior. He adds: The Paddington Borough Council have saved much by altering electric light into gas. Down Maida Vale, the west side is lighted by inverted gas-mantles, the east side by electric light. The former gives a far superior light at about two-thirds of the cost of the latter. In my dining-room, of 5781 cubic feet, one (though I have five) upright incandescent gas-burner lights the whole room, and I can read 24 feet from the gaselier. At my club, under an electrolier of ten 25 candle power lamps, I cannot read as well as under one incandescent gas-burner. With gas there would be no fusing of wires, with its consequences.

The Wandsworth and Putney Gas Company's steam-collier "Wandle" last Wednesday morning came into collision with Wandsworth Bridge, during a fog. Both the steamer and a column of the bridge suffered damage. Vehicular traffic was diverted *viâ* Putney and Battersea Bridges.

THE CO-PARTNERSHIP BILL.

The Bill to promote the adoption of co-partnership by statutory and other companies, which was brought in by Mr. J. F. Hope and other members, and read a first time in the House of Commons last Wednesday week, has now been issued. It is a short measure, consisting of four clauses, and a schedule setting forth regulations for granting co-partnership certificates. It is preceded by the following

MEMORANDUM.

The Companies Amendment Act (Co-Partnership) Bill represents a tentative effort to encourage the principle of co-partnership in the industrial life of the country. The main objects of the Bill are, first, to enable companies to adopt co-partnership in cases where they would otherwise be debarred from doing so, either by their Private Acts of Parliament or their Articles of Association; secondly, to set out in the form of a schedule a model scheme of co-partnership for their voluntary adoption; and, thirdly, to provide that such model scheme shall ordinarily be a condition for granting statutory power to new companies to raise capital, though, of course, without attempting to fetter the discretion of Parliamentary Committees in individual cases.

Under this scheme, certificates of partnership in the objects of the company and a share in its surplus profits are to be granted to all persons in its regular employment. It is provided that the standard rate of wages shall be taken to correspond with a standard return of 5 per cent. on all paid-up capital; and when the return is higher than 5 per cent., the employee becomes entitled to a bonus calculated at one-twentieth of his existing wages for every extra 1 per cent. paid in dividend. Thus, a company with a paid-up capital of £100,000, and a normal wage bill of £20,000, would, if it paid 6 per cent., have to give its employees an extra £1000, or £21,000 in all; if it paid 10 per cent., £25,000; and if it paid 15 per cent, £30,000. Similarly, a workman with a standard wage of 30s. a week would get 31s. 6d. on a dividend of 6 per cent., 37s. 6d. on a dividend of 10 per cent., and 45s. on a dividend of 15 per cent. As, however, it is not desirable that the whole bonus should be paid over in cash, it is provided that trustees shall be appointed, to whom at least half the bonus shall be paid, and by whom it shall be invested, if possible, in the shares of the company itself.

Further, in order to meet the varying circumstances of different industries, it is provided that in the case of registered companies the Board of Trade may allow other regulations to be substituted in individual instances, and in particular may allow a lower rate of bonus when salaries and wages bear a specially high proportion of the annual cost of the business of the company. There are also provisions for the election of trustees and directors, and for the adjudication of differences.

THE CLAUSES.

The clauses are so brief that they may be set out here.

1.—The Companies Clauses Consolidation Acts, 1845 and 1888, shall be amended by the addition to them, as a new section, of the words, "The company shall have the power to grant, and shall be under the obligation of granting, certificates of partnership to persons in its employment according to the regulations set forth in the schedule to this Act."

2.—The said Acts shall be further amended by the addition to them, as a new schedule, of the schedule to this Act.

3.—Every company incorporated by Act of Parliament and every company registered under the Companies (Consolidation) Act, 1908, shall (if not already so empowered) be deemed to have power, without further authority of Parliament or application to any Court, to grant certificates in accordance with the aforesaid regulations. Provided that the company may, with the consent of the Board of Trade, substitute other regulations for those in the schedule, and may, in particular, substitute some other figure for the figure 5 per cent. per annum as the rate of bonus in the said schedule—regard being had to the proportion borne by salaries and wages out of the total annual expenditure of the company.

4.—This Act may be cited as the Companies Amendment (Co-Partnership) Act, 1912.

Some Interviews.

Probably largely as the result of the introduction of the Co-Partnership Bill, much interest is now being taken in the question by the newspapers, and a number of interviews have been published during the last few days.

Explaining the Gaslight and Coke Company's scheme to a representative of the "Pall Mall Gazette," the Governor (Mr. Corbet Woodall) said the Company were quite sure that it had given them a more cordial and friendly body of workmen than they would have without it. It brought into the undertaking an element of brotherhood. "I think," continued Mr. Woodall, "the fact that the men may be called upon to submit to a reduced income as well as to hope for an increased one operates to bring about this more friendly spirit. There is one feature of the scheme that I value highly, and that is that at all our works we have small committees to consider and aid the co-partnership scheme in its work. They appoint representatives to a central committee, which meets me about once a quarter. At these meetings we discuss any questions that are likely to forward the work of co-partnership, and at the same time avoid anything that would be likely to interfere with the management. The Company have tried earnestly to get into closer touch with the men; and I have been very pleased with the results. The gas industry is peculiarly adapted to a co-partnership arrangement; but I see no reason whatever why, in all cases where balance-sheets are published, the principle should not be applied. In railway companies, for example, it would seem comparatively easy to apply it by basing the bonus on the dividend; and in municipal undertakings I see no reason why it should not be extended to all employees in gas and electricity departments—simply fixing a

standard of price for the consumers, and letting the bonus go up and down from this price.

Similarly questioned, Mr. Charles Carpenter, the Chairman of the South Metropolitan Gas Company, said: "What has been the result to the South Metropolitan Gas Company of this co-partnership? For twenty-two years we have had unruffled industrial peace. Our men do their work with goodwill, and intelligently enter into the requirements of their duties. Think of the difference between a willing and an unwilling worker! What percentage in value might it not reach? Our men carry the flag of our business all over the area we supply with gas. What must it not be worth to us to have the thousands of jobs necessary in the houses of consumers of gas performed by men who have an interest in our business and are attached to us." Mr. Carpenter handed the interviewer over to Mr. Henry Austin and Mr. N. Newbold. Dealing with the actual benefits of the scheme, Mr. Austin showed that if a workman earning 30s. a week had invested his bonus year by year since the scheme began, he would now hold £135 of stock, and would have received £52 by way of interest, making a total of £187. The total bonus declared has been £548,708, the interest on the men's savings £33,625, and the dividend on stock during the twenty-three years £100,000—making a total of £682,333. The men invest a good deal of their savings as well as their bonuses in the Company's stock, as is shown by the fact that in the last three years the amount of the bonus has been £114,866 and the market value of the stock purchased by the men £121,380. Of the officers and men of the Company who are now substantial co-partners, Mr. Newbold mentioned that there are 434 who hold stock of the value of £100 and upwards. Of this number, 130 hold £200 and upwards, 13 hold £400, and 25 hold between £500 and £1000 each. Eight hold more than £1000, and 2064 hold amounts of £50 and upwards.

Replying to a representative of the "Globe," Mr. F. M'Leod, the Secretary of the South Metropolitan Company, said: "To-day our men hold over £300,000 worth of our stock. The men are encouraged to hold the stock against old age; but it is very useful in case of any emergency. Incidentally, this system would relieve the labour market to an extent little suspected if it were generally adopted. At present the average workman has to keep on working almost until he drops, but the men in our employ will be in a position to retire at a much earlier age than they would otherwise be able to do, and thus make way for fresh labour. As for co-partnership as a means of dealing with labour unrest, what stronger argument could you have for its value than our own experience?"

GAS COMPANIES' BENEFIT FUNDS.

The Bill promoted by the Brighton and Hove General Gas Company, the Lea Bridge District Gas Company, the Maidenhead Gas Company, the North Middlesex Gas Company, and the Southgate and District Gas Company, for the provision of a sick benefit fund, which has already been passed by the House of Lords, and full particulars of which were given in the "JOURNAL" for May 7, p. 379, came up before the House of Commons Committee on Unopposed Bills last Thursday, when the preamble was proved.

BRODSWORTH AND DISTRICT GAS BILL.

The Unopposed Bills Committee of the House of Commons—the CHAIRMAN OF WAYS AND MEANS presiding—had before them last Thursday the Bill promoted by the Brodsworth and District Gas Company.

By the Bill power is sought to dissolve and re-incorporate the Brodsworth and District Gas Company, Limited. The Company was incorporated in the year 1909, with a nominal capital of £15,000, which has been fully paid up, and no money has been borrowed on mortgage. Gas-works have been erected at Skellow and Askern, in the West Riding of York. The Askern Gaslight Company, Limited, are supplying gas within parts of the limits defined in the Bill, and it is sought to amalgamate the two Companies. The Brodsworth Company are to purchase the undertaking of the Askern Company for a sum of £6000. The Bill contains a special clause dealing with residuals. The capital of the new Company is to be £42,000—*i.e.*, 21,000 ordinary shares of £1 each. Of these shares, 15,000 are to be allotted to the registered members of the original Brodsworth Company, in proportion to their shareholdings in the Company, and the remaining 6000 to the members of the Askern Company. The additional capital of £21,000 may be raised as required by the issue of ordinary or preference shares, subject to the usual conditions. The limits within which the new Company wish to supply gas are the parishes or townships of Brodsworth-cum-Pigburn, Scausby, Adwick-le-Street, Owston, Thorpe-in-Balne, Skellow, Burghwallis, Skelbrooke, Marr, Hampole, Askern, Norton, Campsall, Sutton-near-Doncaster, Moss, Fenwick, Little Smeaton, and Kirk Smeaton, all in the West Riding of the county of York. At present, there were 1500 consumers; and it was anticipated that an additional 2000 would be connected to the mains during the next four or five years. The standard price they were asking was 3s. 6d. per 1000 cubic feet, which was 3d. lower than the lowest charge at present made in the Brodsworth district—3s. 9d. by ordinary meter, and 4s. 2d. by slot meter. These prices include supplying and connecting fittings, burners, &c., to the mains. The present standard price in the Askern Company's area is 3s. 11d.

The CHAIRMAN remarked that he thought 3s. 6d. was a high price, taking into account their position in a coalfield. It was stated, however, that they obtained their coal from the Barnsley district, as that in their own area (steam coal) was not suitable for making gas.

Evidence was then given, at the request of the CHAIRMAN, by the Manager of the Company, who said that the present population of 5000 would probably double itself in five years. There were now 300 new buildings in course of construction, and the Brodsworth Company had built a model village. All their works plant was quite modern. Developments had taken place much more rapidly than they had anticipated, and, therefore, they wanted to raise more capital. They had an agreement with the Rural District Council as to the maximum price which might be charged; and they were now selling at 5d. below this figure.

In answer to a question by the CHAIRMAN, witness said they were five miles from Doncaster, where the gas-works were owned by the Corporation; and the price of gas there was from 2s. 4d. to 2s. 6d. per 1000 cubic feet. The nearest district to Brodsworth was a very compact one, and the price charged was 3s. 4d. The next nearest was a scattered one like their own; the charge there being 3s. 9d.

The preamble of the Bill was then declared proved.

MISCELLANEOUS NEWS.

GAS COMPANIES AND DEPRECIATION ALLOWANCES.

Mr. W. A. Schultz, under date of the 19th inst., has issued a circular-letter addressed to gas companies throughout the kingdom, in which he criticizes the basis of settlement proposed for depreciation allowances in respect of income-tax returns at the meeting held at the Royal United Services Institution during Gas Institution Week, as reported *ante*, pp. 886 89. Mr. Schultz says he is strongly of opinion that, while the suggestions then put forward "may suit the purpose of the great Metropolitan and City Companies," it "would be greatly to the disadvantage of new companies and companies of moderate size," and he considers that the full claim for depreciation should be insisted upon.

The circular-letter refers to the fact that, in the "JOURNAL" for Aug. 31, 1909, Mr. Schultz called attention to a circular issued by the Board of Inland Revenue to their Surveyors regarding the allowance of income-tax in respect of depreciation of gas and water undertakings which provided that:

> "No depreciation should be allowed, in any circumstances, in respect of any portion of these undertakings. Repairs and renewals (excluding extensions and improvements) to be allowed as working expenses, as and when incurred."

He then pointed out, "for the benefit of the gas industry," that this circular emanated only from the Board of Inland Revenue, who, in this matter, were the opponents of the companies; and, further, that it was most important that gas companies should take care that their view of the case was brought before the Commissioners of Taxes, "who are the ultimate judges and before whom each case may be brought to appeal." Since that date he says he has conducted a number of cases to appeal before the General and also the Special Commissioners of Taxes of England, Ireland, and Wales; and in every case he has been successful "in establishing first of all the principle that companies are entitled to an allowance for depreciation of plant and machinery, and that the Commissioners of Taxes have no option in the matter but must allow such sum as they consider fair and reasonable." The circular continues:

The principle having thus been established, the rate of depreciation on the various items of plant and machinery had to be settled. In those cases which I have now carried to appeal, I have succeeded in obtaining from the Commissioners of Taxes allowances ranging from 2 per cent. to 10 per cent. on gas plant grouped under the following heads: (1) Gasholders; (2) mains; (3) services; (4) all plant and machinery other than gasholders; (5) meters, cookers, and gas-fires; (6) house fittings.

As I had several cases pending, and the Commissioners of Inland Revenue being apparently satisfied that they can no longer resist the claim of companies in principle, I agreed with them to hold in abeyance the hearing of certain appeals pending our coming to an arrangement which would be acceptable to the bulk of gas companies other than those I represented.

The position at present appears to be that the Commissioners of Inland Revenue would agree to a depreciation of 3 per cent. on the written-down value of gasholders and 10 per cent. on meters, cookers, and gas-fires, *but renewals only in respect of the other items.* To this, I cannot agree on behalf of twenty or twenty-five companies which I represent; and I therefore propose to proceed on the following lines:

(1) Gasholders: To claim an allowance of 3 per cent., which I consider reasonable.
(2) Mains (cast-iron): To claim an allowance of 2½ per cent., and steel mains (if any), 7½ per cent.
(3) Services, and (4) All plant and machinery other than gasholders: To claim an allowance of 5 per cent.
(5) Meters, cookers, and gas-fires, and (6) House fittings: To claim an allowance of 10 per cent. in respect of these.

The whole of the above to be on the written-down value.

In all cases where depreciation allowance is granted, it is understood that repairs and maintenance may be charged to revenue in addition, but not renewals and replacements.

Mr. Schultz concludes in these words: "I may say that my representative with others present at the meeting referred to, representing a considerable number of companies, did not agree, and I hope your company will not agree, to the proposals put before the meeting. On the contrary, I shall be glad to hear from your company that you agree with my view, and would support the settlement of a more liberal allowance on the above lines. By your reply you will, of course, not be committing your company to any expense. Meanwhile, in making your return for 1912-13, I should advise you to claim depreciation at the above-mentioned rates."

[Reference to the above suggestion is made in a paragraph appearing on our leader pages to-day, p. 962.]

ILKESTON GASHOLDER AND TANK DISASTER.

Government Inquiry—Engineering Evidence.

After an interval of over five months since the occurrence—suggesting almost the idea that further official action was not contemplated—the subject of the accident which took place on January 8 at the Ilkeston Corporation Gas-Works, was revived last week, when a Government inquiry occupying two days was held at the Town Hall, Ilkeston, eliciting a further considerable volume of engineering evidence in relation to the matter. The investigation which began on Tuesday had been ordered by the Home Secretary under the provisions of the Factory and Workshop Act, 1890; the conduct of the inquiry into the "causes and circumstances" being entrusted to Mr. A. G. DRURY, M.Inst.C.E., one of the Engineering Inspectors of the Local Government Board.

Mr. W. J. WAUGH, K.C, with whom was Mr. J. J. JEEVES, instructed by the Town Clerk (Mr. S. F. James), appeared on behalf of the Corporation; Mr. GRAHAM MILWARD, of the Oxford Circuit (instructed by Messrs. Pinsent and Co., Solicitors, Birmingham), representing Messrs. C. & W. Walker, Limited, of Donnington, Salop, the makers of the gasholder in connection with which the accident occurred. Among those also present were Mr. J. H. Walmsley, of Birmingham, H.M. Superintendent Inspector of Factories; Mr. C. R. Pendock, Inspector of Factories for the Derby district; Mr. Samuel Glover, of St. Helens, and Mr. J. Ferguson Bell, of Derby, the two latter of whom were called in after the explosion, and acted at the inquiry as technical advisers to the Ilkeston authorities.

The INSPECTOR said the object of the inquiry was to investigate and, if possible, to determine the causes of the accident, which was unfortunately attended by loss of life. It was a mercy that the loss of life was not greater under the circumstances. It would be the duty of all parties concerned to throw any possible light they could on the matter, and he hoped that every assistance necessary in arriving at a proper conclusion would be forthcoming.

Mr. WAUGH said the Corporation desired to place before the Inspector all the facts available in order to arrive at a proper solution of the matter.

Mr. *F. C. Humphrys*, the Ilkeston Corporation Gas Engineer, was, at the suggestion of the Inspector, the first witness called and, examined by Mr. WAUGH, gave details of the occurrence. He explained that he had occupied the position of Manager since 1879. The tank and holder the subject of the inquiry were prepared according to specifications by Messrs. Walker. Witness explained he did not actually prepare the plans himself, but saw them and approved of them. A copy of the contract with Messrs. Walker was produced. Witness added that he merely endorsed the specifications prepared by Messrs. Walker, who also furnished the plans. A Local Government Board inquiry was held on May 13, 1908, in connection with an application for borrowing money for erecting the gasholder. The late Mr. Wright Lissett was then Town Clerk. The specifications submitted for the approval of the Inspector on that occasion included an underground tank of brick and puddle. There had been negotiations before the date of the inquiry for the construction of a steel tank, but whether the tank should take that form had not then been actually decided upon. The contract with Messrs. Walker was entered into in October of that year; and the tank and holder were erected in accordance with the plans, witness superintending the erection. When handed over by Messrs. Walker, he approved of the work, after certain alterations in detail had been made. The holder was first filled on April 20, 1909. The Corporation were induced to substitute a steel tank for the brick and puddle tank originally proposed as being more suitable in a mining district. The Gas Committee visited various other works, and as a result of the information there obtained decided upon a steel tank. The works were being generally extended at the time, and the Committee were appointed to consider the best methods of modern construction. The holder was used continuously from April, 1909, until the date of the accident. It worked quite satisfactorily. There was nothing to indicate prior to the accident that it was not in working order. He saw the holder within half-an-hour of the accident, and everything then appeared to be working smoothly. He made a detailed examination of the holder a month or fortnight before the accident. There was nobody told off from the staff to make an examination periodically. The foreman might, in addition to witness, upon whom the responsibility rested, make an examination from time to time. The examination which he made a short time before was directed mainly to seeing that the guides were all working properly within the rollers. There was nothing to indicate at that time that the holder was not in perfect working order. The holder was spirally-guided. Witness gave details of the accident which have been already published, stating that he had left the works only half-an-hour before the explosion took place.

The INSPECTOR explained that some days after the accident, and before the *debris* was cleared away, he himself visited the works.

Mr. *Humphrys*, continuing his evidence, said it was difficult upon the materials available to say what happened first in connection with the explosion. He thought one or more of the guides working the holder on the outer lift must have got jammed. It would cause the inner lift to come down rapidly. Gas was being withdrawn from the holder for use in the town and for filling one of the other holders when the accident occurred. The firing of the escaping gas ensued through some cause which had not been definitely ascertained. It might, he thought, have been caused by friction giving rise to a spark when the holder came down. He had not ascertained whether there was a fire in a house in Belfield Street (adjoining the works) from which sparks might have come—causing the firing of the gas. The chimney of that house was demolished by the explosion. He did seriously think that a spark might have been caused through friction when the holder rapidly dropped. The gas, on lighting, would tend to expand the contents of the holder, producing such heat as to cause the material of which the holder was composed to expand, exerting pressure on the tank. The tank not having sufficient power to resist the pressure would give way. From his examination of the materials of which the holder was composed, it was evident there had been very great heat in the holder. There was a fairly strong, but not excessive, wind blowing at the time of the explosion, going in the direction in which the holder went out. There was nothing, however, abnormal about the wind pressure.

The INSPECTOR said records which he had obtained from the Meteorological Office showed that the wind in the district on the day in question was slight. At Nottingham, the nearest point from which the record was available, it was blowing on the day in question in a southerly direction, and at the rate of about 10 miles an hour.

Mr. *Humphrys*, replying to further questions by Mr. WAUGH, said appearances pointed to the first fracture of the tank occurring at the top. There were about 1¼ million gallons of water in the tank at the time of the accident. He went into the holder afterwards. All the gas had not then escaped from the top of the inner holder. He was able to breathe at the bottom of the holder itself.

In reply to the INSPECTOR, Mr. Humphrys said there had been no subsidence or fracture of the present underground brick tanks in use at the works. It was, however, thought advisable, under more modern conditions, to construct a steel tank in connection with the new holder. Alternative tenders were obtained for brick and steel tanks. Contracts were not advertised for for the steel tank; but certain firms were invited to tender—these including Messrs. Clayton, Son, and Co., Westwood and Wrights, Newton, Chambers, and Co., R. & J. Dempster, and C. & W. Walker.

The INSPECTOR intimated that he should like to see the specification of the other makers for purposes of comparison.

Mr. *Humphrys* said he had not kept them. They had been destroyed. There were a great number of them.

The INSPECTOR said it was unfortunate that these papers had been destroyed, as they would have been useful in forming a guide as to what were the specifications of the other firms.

Mr. WAUGH said that Clayton's tender for the holder was £3701 and for the tank £2331—a total of £6032; there were two others of about £5700 each; Dempster's tender was £5300; and that of Walker £5086.

Replying to further questions by the INSPECTOR, Mr. Humphrys said that in connection with the contract there was no stipulation as to the working stress put on the metals. That was left to the contractors.

Mr. WAUGH said the contract with Messrs. Walker (from which he read) required that the materials and workmanship should be of the highest quality and to the entire satisfaction of the Engineer.

The INSPECTOR: There were no working stresses specified.

Mr. WAUGH: No; it was left entirely to the Contractors.

The INSPECTOR: Did not the Corporation require some test of the materials?

Mr. WAUGH: No. The tests were made by Messrs. Walker and forwarded to us.

Mr. MILWARD: It was all that was required of the Contractors.

Mr. *Humphrys*, in answer to further questions, said he had had no previous experience of spirally-guided holders. It was necessary in regard to such holders, of course, that the tank should be of greater strength. He did not visit Messrs. Walker's works during the course of the construction of the holder. There were other spirally-guided holders in use in the district; the nearest being at Langley Mill. He was not able to express any opinion as to the working stress of material in the tank. He did not know whether the stress was heavy or light, not having gone into it beforehand. He did not attribute any importance to excessive wind pressure in connection with the accident, as they had had experience of much higher winds. The rollers, which were grooved, had not jammed on those occasions. There was ample play on the pins for any expansion or contraction. There was no excess of play allowed, however. It was clear there was jamming on the day of the accident, because the inner lift came down before the outer. There was evidence at the inquest of a witness who said he saw the holder on fire before it dropped. There was very short time before the escape of the water. He was of opinion the gas escaped first. It might have been expected perhaps that the holder would have buckled first through the jamming, and before the fracture of the tank occurred. There had been a frost on the night preceding the occurrence. He did not think, however, the disaster could be attributed either to change of temperature or to the wind. From an examination of the holder after the accident he was perfectly satisfied with the quality of the materials used in the construction.

In answer to Mr. MILWARD, on behalf of the constructors, witness said five firms were asked to tender for the work. They all agreed as to strength; but there was some variation in detail. He had seen several tanks of this character, including one at Barry, in South Wales, before the orders were issued for the Ilkeston work. The balance due on the contract with Messrs. Walker was paid within two months of the completion of the contract, when his certificate was given. He gave his certificate; and from that date up to the time of the accident there was no complaint at all necessitated. The holder was used every day—practically the whole of the work being done by it, and there was no cause for complaint.

Alfred Garner, an employee at the works, was next called. He stated he was engaged in filling the elevator on the south side of the yard when he happened to look up and saw a flash of light above the holder, and heard a rumbling sound. The next moment he was washed off his feet by the rush of water, and carried through the doorway and into the back yard. He did not think it would be possible for sparks to get out of the motor which worked the coal-elevator and so cause the explosion. The motor was enclosed.

George Herbert, the yard foreman at the works in Rutland Street, said that careful examination of the guides and rollers previous to the accident failed to reveal any jamming. There was a ladder standing by the side of the tank; but he did not think any maliciously inclined persons had got up to interfere with the rollers. He had not noticed any escape of gas as he passed the holders. He sometimes greased the rollers, but he had never found anything wrong with them.

George Beckwith, another employee, also gave evidence.

Thomas Bostock, who had charge of the motor at the works, said after the bursting of the tank, there was a great wall of water visible.

Thomas Hallam, a butcher, of Rutland Street, who was walking in the road contiguous to the works when the explosion occurred, also described the collapse of the holder and the rush of water—saying he heard at first an immense cracking noise. He saw the water first, flames afterwards shooting up from the top of the holder. The holder appeared to be twisting round before the collapse. The flame lasted only a very brief time.

George Bostock, the occupant of the premises in Rutland Street into which the water rushed, said following the explosion the whole of the gas-works yard appeared to be in one immense flare. Walls and outhouses in the neighbourhood were swept away by the water. Previous to the explosion there was no smell of gas noticeable more than was usual in connection with the works. The flames might have leapt up twice the height of the holder. He had no fire in front of his house at the time of the explosion, but there was a small stove with glowing coal in it in an outhouse near the works. He did not think, however, that the explosion of gas was caused by the lighted stove, as it was closed.

Mr. WAUGH: But wherever the air could go the gas could also penetrate, and the conclusion is obvious.

Witness, answering further questions, said he did not know what became of the stove after the explosion. It was broken to pieces.

This concluding the evidence of eye witnesses as to the occurrence, technical testimony was taken, the first witness being

Mr. *Samuel Glover*, M.Inst.C.E., Engineer and Manager of St. Helens Corporation Gas-Works. He said he visited the scene on the morning after the accident, as soon as it was daylight. Nothing had then been moved, and he was enabled to make a complete inspection. He had since visited the works several times. He had heard the evidence given, and had ascertained all the circumstances as far as was possible as to what occurred previous to the accident. With regard to holders of this character, they were in common use in the country. Some were larger than this one. From the examination of the damaged parts, there had been nothing in his opinion previous to the accident to draw attention to any inherent weakness of the tank.

Mr. WAUGH: Have you formed any opinion as to what was the cause of the fracture of the tank?—The tank was very badly ruptured. It must have begun with the fracture, and then continued until the whole thing was destroyed in the way it was found.

Have you formed any opinion, as an engineer, as to what caused the fracture of the tank?—I found that the strain which a tank of that construction is usually put to when in use had been emphasized in some way or other.

In the course of further evidence as to what probably occurred at the time of the accident, Mr. Glover referred to the evidence of certain witnesses living in the neighbourhood as to hearing sounds as of knocking proceeding from the holder.

The INSPECTOR: The knocking was caused by the guiders slipping.

Mr. *Glover*: By working irregularly in some way.

Mr. WAUGH: The foreman stated that the working was regular, and he had no cause of complaint. It might be necessary to recall him to see if there was any noise heard.

Mr. MILWARD: I cannot accept any statements unless they can be followed up. Where did Mr. Glover get this information as to knocking?

Mr. *Glover* replied that he could not say; but it was on the day he was engaged in making investigations on behalf of the Ilkeston Corporation. He simply submitted it as a fact that holders of this description if not beautifully balanced and constructed were apt to show such signs. He did not remember who suggested the knocking in this particular instance.

Mr. WAUGH suggested that the witness Bostock, who lived very near to the works, might be called as to this point, but

The INSPECTOR observed that probably the actual employees on the works would know better than anyone else.

Mr. *Glover* explained his theory of how the accident occurred. He said that it seemed to have been suggested to his mind, inasmuch as the holder was distributing gas at the time. It was full in the forenoon, and it had worked quickly during the forenoon. At one o'clock it would be still descending but working slowly, inasmuch as at one o'clock the mills stopped. The fact that the holder was working slowly might interfere with the outer lift descending properly into the tank, when the inner lift would take up the running and begin to descend without drawing attention to the fact it was working until the seal and cup—the telescopic arrangement of the two lifts—had become unsealed, when the inner lift would descend into the outer lift, going very freely, emphasizing the strain to which the tank was then being subjected.

The INSPECTOR: The inner lift would fall until the bottom edge touched the water. There was a cushion?—That is so.

It would be a cushion of water?—Yes.

In what other way was there shock?—The water might not take the whole of the strain. It would be a beautifully balanced instrument if the guides were working perfectly all the way so that the inner lift hit the water as on a horizontal surface.

Mr. WAUGH: Have you heard of such a thing as hydraulic shock?—Yes.

Supposing this came down with sudden force on the top of the water, would that set up a strain in the immediate neighbourhood?—Not taken through the water so much as through the guiders to the sides of the tank.

The INSPECTOR: You do not suggest that the pressure of the water against the sides of the tank would be suddenly increased?—It would not be sufficient. The holder would be more inclined to rebound than give much downward thrust to the water.

Mr. WAUGH: In your experience have you known of other dips becoming unsealed in gasholders of this description?—Yes.

Not with the same result, I suppose, as in this case, but with the result that the holder has suddenly gone down?—Since this happened, I have had several distinct cases given to me illustrating the fact.

Cases, I take it, not occurring since this one, but which have come to your knowledge?—That is so.

That is that holders of this description have behaved in a similar way to that in which this behaved?—Yes; and holders of every description—not particularly this class.

The INSPECTOR: Do you mean that other instances have been brought to your knowledge in which the outer lift was jammed allowing the inner lift to drop?—Or for some reason the inner lift had become unsealed and descended, discharging gas into the air. But in those cases the explosive mixture formed outside did not get lighted, and the accident was much slighter.

By means of the model which was used at the inquest, Mr. Glover illustrated the working of a gasholder, explaining in detail, which was reported on that occasion [see JOURNAL for Jan. 30, 1912, p. 306], what be believed happened in regard to the burning of the gas and the subsequent collapse of the tank, followed by the escape and rush of water. All happened, however, in such a short space of time that he admitted it was very difficult to follow the exact sequence of events. It was more or less supposition; but what he had described he believed was what happened to the holder. He could not think that it occurred in any other way. He pointed out that there was the fact to be remembered that the structure had stood three years, working satisfactorily, as Mr. Humphrys had said. If there were some little things that arose, they were not sufficient to cause Mr. Humphrys any anxiety as to the working of the holder. It showed, if anything, that the tank must have been at the bursting point all the time, and only needed some little extra strain to bring it about. Some extraordinary strain must have been thrown upon it at the moment of the accident. When he used the expression "extraordinary strain," he meant something in addition to the pressure of water.

Mr. WAUGH: Did you make an examination of the tank walls?—I cut out from the tank wall two pieces of steel which seemed to have broken up very much and had them submitted to the Whitworth Institute, Manchester, and under the tensile test which was applied the behaviour of the steel was quite good. The strain it withstood was upwards of 27 tons per square inch. That is the strain which I submit these tank plates ought to stand.

The INSPECTOR: You do not mean that they have to stand that?—No; I was emphasizing the tensile strain. It was the tensile strain they were submitted to and which they had to stand. The 9-16th plates at the bottom were slightly better than that.

Mr. *Glover*, in the course of further evidence, said he did not know whether there was anything in the composition of the plates to lead to their early decay. He was fairly satisfied with the test to which the material was submitted. It seemed to him that the plates justified their use. If he had found that they were faulty in any respect, he should have called the attention of the Ilkeston Corporation to it when making his report. He desired to be very careful in the matter; but he must say, in regard to the contract, that he should very likely have done exactly as Mr. Humphrys and the Gas Committee did had the contract been submitted to him at the price it was by Messrs. Walker.

The INSPECTOR: At the price—what do you mean?—That was the market price then; but you would not be able to get such a tank to-day at the price. I want to make it quite clear. If the tank were submitted to-day at that price, you would not get as good a tank. Such a tank as this, submitted by responsible makers, could very reasonably have been accepted as a satisfactory job, inasmuch as it could be compared with other tanks supplied by the firm and which have been in existence for a longer period.

Mr. WAUGH: And have given satisfaction?—Yes; their continued working suggests satisfaction. If you ask now whether the same factor of safety should be accepted, I should say, perhaps, we ought to learn from this experience that we are sailing too near the wind.

Mr. *Glover*, in reply to further questions, added that obviously something abnormal occurred on the day of the accident. The damage caused to the surrounding works and property was very largely by flood and not by fire. If the tank had been underground it would not have happened; and if the gas had not become lighted at the moment, they might not have heard anything of it at all.

The INSPECTOR: Have you had experience of spirally-guided holders at your works?—I have not adopted them.

You do not like them?—I would not say that. Engineers ought to apply that which is best for their particular works There are circumstances under which I would certainly adopt a spirally-guided holder.

You do not like the steel tank being unsupported?—I do not like a huge reservoir containing so much water being subjected to such a strain as this was and standing exposed at the yard level.

In the circumstances under which you would use spirally-guided holders, would you place any limit on the size?—There are some very large ones being put in that I know of, but not in steel tanks.

Have you erected any steel tanks of any sort?

Mr. *Glover*: For any purpose?

The INSPECTOR: Yes.

Mr. *Glover*: Various sorts, but not for gasholders.

What do you consider the proper factor of safety to employ in cases of gasholders of the spirally-guided type?—Four times has been considered quite enough; but I should like to increase it if I had the responsibility, and especially if they had to stand on foundations such as these.

You mean that for an ordinary gasholder tank, column guided, you ought to have a factor of safety of 4?—For column-guided holders I should want that factor of safety, when I had taken the precaution to carry the standards down to the side of the tank and made them part of the structure.

Supposing the tank had nothing else to do but hold the water, would you adopt a smaller factor of safety than 4?—No.

Mr. *Glover*, replying to further questions, emphasized the consideration that he did not think the factor of safety ought to be smaller than 4. It was to provide against bad workmanship, bad materials, and other contingencies. He would have accepted this tank at the time of the contract.

The INSPECTOR: Is it your practice to accept makers' specifications and drawings without satisfying yourself of their accuracy and reasonableness?—It may be done in conjunction with the contractor.

It is hardly fair on the contractors for one thing?—No. I find contractors very ready to accept any suggestions which are made.

You would have satisfied yourself that the structure was adequate for the work it had to do before you accepted it?—I hope I should.

Mr. *Glover* added that, naturally, in the construction of holders all

allowances should be made for wind pressure, and it had been found that spiral holders were very rigid in resisting wind. Asked if he thought wind pressure contributed to the disaster in this case, witness said that with proper construction it ought not to be necessary to take into account such wind as was blowing on that day. Changes of temperature did affect holders to some extent; and in this connection he agreed as to emphasizing the importance of play being allowed on the pins of the wheels. In this instance due allowance must have been made, as the holder had worked three winters. The weather was changeable on the day of the accident—at any rate, he knew it was at St. Helens. Just before he received the Town Clerk's message, asking him to come to Ilkeston, he was driving to the works from home after lunch, and there was a fearful blizzard.

The INSPECTOR: Was there a blizzard here on that day?

Mr. PENDOCK said he had a note as to the day stating there was a blizzard.

The TOWN CLERK: There was a high wind. The wind dropped and there was a blizzard after the explosion.

Mr. *Glover* observed that there was evidently an assembly of influences on the occasion.

The INSPECTOR: There was nothing very abnormal in the change of temperature. There might have been many days when there was a greater range.

Mr. *Glover* said it was rather emphasized on the particular day. He had not got out the figures as to the stresses. Mr. Bell had done so, and he was guided by Mr. Bell on this matter. He (Mr. Glover) had not gone fully into the question of the sufficiency of the riveting or thickness of the plates; but some suggestions had occurred to his mind as to what considerations should obtain in regard to future work of the kind. He suggested there ought to be butt joints and cover plates inside and out on all plates of ½-inch thickness and upwards.

The INSPECTOR: In this case the plates overlap. Do you think in the present instance there was not sufficient lap?—I should like to have seen more lap. These are some of the things that impressed me.

Are you disposed to regard this type of gasholder at all as being unsafe?—I have watched them very carefully from the early days when the inventor first introduced them. I think that the problem of their structure and their working is certainly to-day very well thought out.

They are improved?—Yes.

In what way have they been improved?—In the depth of the groove in the wheel, in the section of the guide-rail, and in the attachment of the guide-rails to the sides of the holder. There are other suggested improvements in connection with the rollers and their attachments.

But the principle of the tank remains?—The principle of the tank remains, in that the tank has to receive the strain of the guides.

Would you expect in the case of jamming taking place between the outer lift and the tank that the lift would give way before the tank? Would you expect the lift to buckle before it threw a strain on the tank?—If I had feared anything of the sort, the experiences at Ilkeston would correct it. Whatever happened to the tank, the floating bodies came down into the yard almost unharmed.

In this particular case you think there is not the least likelihood that the tank burst first. You are assuming that the holder was hung-up and brought about the fracture in that way?—I was getting to that. I was influenced by the fact that the tank had stood for three years.

The gasholder had been working satisfactorily for three years?—Yes, and yet this happened. If the tank was not sufficient to stand its work it might have burst, but I was not drawn to the conclusion that the tank burst first. If through an accumulation of forces other than normal if it is thought the tank burst first, those expressing the view are passing very severe criticism on the tank.

The INSPECTOR: It must have been on the point of bursting at the first and from the beginning?—Yes.

The most likely proposition is that the lift jammed and brought some undue load, sufficiently great to upset the balance?—That is the view that appeals to me.

By Mr. GRAHAM MILWARD, for Messrs. Walker: Your opinion is clear that the tank did not burst first from ordinary causes?—Yes, the other explanation appealed to me more strongly from the first.

You know that the tensile breaking point or strength is 27 tons?—Yes, per square inch of the steel plates.

Mr. *Glover* added that his test confirmed this. In answer to further questions by Mr. Milward, he said that the ordinary working stress on the plates ought not to be anything like 27 tons. It all pointed to the fact that there must have been something abnormal to cause the break. That was what he was trying in all truth and honesty to find out. Asked whether he had formed any opinion as to where the tearing actually began, witness said Mr. Bell would speak in regard to that; but he thought it occurred very near to the attachment of one of the brackets, and that it was continued down in the line shown on the plan. If it started at the bottom, it was a greater reflection upon the details of the tank at that point. He thought both points were worth consideration. There was no force which could be exerted at the bottom other than the ordinary weight of water and its own weight. They were bound to take into account that the measure of the stress was in proportion to the measure of the structure to resist it. If Messrs. Walker had submitted a measure of safety which was only 3·75, he thought it would have been better that it should have been more. It should have been 4. Messrs. Walker were a firm with very large experience.

Mr. MILWARD: I may tell you that 3·75 has proved to be an excellent measure of safety up to this moment.

Mr. *Glover*: Sufficient unto the day is the evil thereof. [Laughter.] I hope there is no other tank constructed with the same factor of safety which is to-day on the point of bursting.

The INSPECTOR: You think that the minimum factor of safety insisted upon by engineers for constructional work of this character is 4?—Yes, that is as I understand it. Many of my friends would not go lower than that.

If the factor of safety is less than 4, it is sailing very near to the wind?—Yes.

What is the range of division in different temperatures? What amount of play is allowed in a holder of this size—what is the maximum?—I could not tell you that to-day. The whole structure would be affected by change of temperature. Gas expands and contracts quickly; the ironwork would be the more affected.

In answer to Mr. PENDOCK, witness said that he had never known the sides of holders bulge outwards through change of temperature, but something might occur at the crown, depending upon how it was attached to its framework.

The INSPECTOR: If there had been an underground tank, nothing worse could have happened than the loss of gas and damage to the holder?

Mr. *Glover*: Or a steel tank buried in suitable ground which would have stood what this was subjected to.

The inquiry was then adjourned until Wednesday.

Second Day.

On the resumption of the proceedings, the first witness called was

Mr. *J. Ferguson Bell*, M.Inst.C.E., M.Inst.M.E., the Engineer to the Derby Gas Company, who said he had had large experience in the designing and construction of similar tanks to this. Speaking generally, for a district like Ilkeston, where the ground is undermined, he had a decided opinion that steel tanks were very suitable. In case of getting out of level, they could be more easily put right than could a brick tank. Steel tanks had been generally used for standard and spiral gasholders and for the storage of oil. During the last twenty years, over 750 steel tanks had been erected; the accident to the one at Ilkeston being the first on record. Steel tanks were increasing in favour. Mr. Bell presented a statement of the approximate number of steel tanks erected for gasholders with outside guide-framing and spiral-girded holders very similar to the one at Ilkeston, and also for the storage of oil, &c., during the last twenty years, divided into periods of five years; the figures being as follows:

	Steel Tanks Erected for One to Four Lift Gasholders with Outside Guide-Framing.	Steel Tanks Erected for One to Four Lift Gasholders Spiral Guided.	Steel Tanks Erected for Storage of Oil, &c.
1892 to 1896 inclusive	49	19	29
1897 ,, 1901 ,,	78	28	51
1902 ,, 1906 ,,	95	54	70
1907 ,, 1911 ,,	91	98	89
	313	199	239

Steel tanks, Mr. Bell added, were almost exclusively used for the storage of oil. Of late years, if they took a hundred gasholders no fewer than eighty had steel tanks. With respect to Ilkeston, he had a decided opinion that the Committee acted wisely in putting in a steel tank. Witness produced a plan showing levels which had been very carefully taken round the tank. Speaking generally, the tank was practically level—it being only 1 11/16 inches out. It was upon a very good foundation. There was no evidence of recent subsidence. There was a crack in the concrete on the outside where the tank broke, but that was only a surface crack. The foundation was good. He said definitely that there was no want of level in the foundation contributing to the accident. The capacity of the tank was 1,600,000 gallons. The total weight on the concrete foundation was something like 8000 tons, which gave a load of 15 cwt. per square foot on the concrete foundation. This was very light. The subsoil of the foundation was clay. He had prepared drawings of the gasholder and the steel tank, and these [they were reproduced in the "JOURNAL" for Feb. 6] were now formally put in by Mr. Bell for the information of the Inspector, who said they would be of great assistance, adding that the drawings which appeared in the "JOURNAL" would more conveniently answer his purpose than the larger plans. Witness said he found the gasholder was erected strictly in accordance with the specifications and drawings. He had had tests made of metal taken from the works, and they showed a tensile strength of 27 tons. Before that he carefully calculated the strength of the tank, taking each ring as a boiler, and by means of a diagram Mr. Bell demonstrated the factor of safety. In reference to the suggestion made as to the top roller carriage overhanging, he did not think that it could make very much difference.

The INSPECTOR: You do not think the leverage would affect the stability of the tank?—No, because it would be so well supported by angle brackets and gusset plates.

Mr. *Bell* said that the broad result was that he found the factor of safety on the bottom plate was 3·4. He did not think that in this respect he was taking too favourable a view. Details of the factors of strength in regard to the other plates were also given by the witness, who, in reply to further questions, said as to the rivets the pitch was 3½ inches. Had he been responsible for the work, he would have put a little closer pitch. It was difficult to say whether the fracture of the tank commenced at the top or bottom. He should not like to state anything definitely on this point, but some extraordinary force had been thrown on the tank from the guide-carriage. The fracture did not go through the line of rivets at the top, but started from the side of the guide-carriage. The fracture at the bottom, however, went through a line of rivets. The fracture at the top went through a solid line of plate. It got hold of the rivets slightly and then ran out again. It was impossible to have metal all of equal strength. This steel varied somewhat, and would necessarily tend to vary the line of fracture. It was possible that the fracture started at a joint at the bottom, but it was very difficult to say. It was, in his view, due to some sudden strain temporarily put on the tank by the holder that the accident happened. Witness produced a sample of the metal tested. He did not think there was any fault to be found with the materials, so far as tensile strength was concerned. It was Bessemer basic steel, which varied in character. He thought there must have been some jamming of the guide-rollers to cause the extra strain and ripping of the tank, which had previously stood for three years and had worked perfectly satisfactorily to the manager.

The INSPECTOR: It might have been on the point of failure during all these three years?—That there was some abnormal strain was shown by the holder having stood the weather for three years. In

regard to the factor of safety, which in the case of the Ilkeston holder was 3·5, he might have accepted it as covering all contingencies; but it was rather on the weak side. Being a low factor, great care should have been exercised to see that the full factor was secured. He would prefer to see a larger factor—say 4, which would cover everything. This ought to be the minimum. In case of jamming in the holder he would not expect the lift to buckle and give before the tank. As far as the sheeting was concerned, the lift was thin; but the guide rails were strong, and would stiffen it. The tank was the weak part. Although the bottom plates were amply strong, the side plates were light.

You found nothing in the lifts to cause the jamming—you did not find any wooden wedges?—No.

So that it is entirely theory as to the jamming?—Yes.

Mr. *Bell* gave particulars as to holders erected to his own designs, and under his supervision also, at Belper and Burton. He prepared the specifications, which he thought was better than to entrust the work to the contractors. He did not suggest that Messrs. Walker would do so, but there was a tendency to pare down the factor of safety, which many manufacturers put at 3·5. The strength of a tank for a spiral holder should be greater than for a column holder—especially the top curb. He considered the factor of safety should not be so low as mentioned in this instance. He thought 4 ought to be the minimum. The Ilkeston tank might have been accepted as providing for all contingencies, but it was rather on the weak side. He had had holders of his own jam—but not spiral holders—and they had descended through unsealing owing to some undue pressure or loss of water. He had never known of any spiral holder jamming except in this case. Spiral-guided holders required more attention than others; but experience showed that they were safe. The danger of tilting was obviated in regard to such holders by the self-locking guides. He considered sufficient play was given in the case of the holder to allow for expansion. There was not much variation in the play required. Something probably got into the groove to cause jamming in this case—possibly wood.

Mr. MILWARD pointed out that the holder was very near the road, and it was quite possible for somebody from outside to have thrown up a piece of wood which caused the jamming.

Replying to the INSPECTOR, Mr. Bell said that, in the case of this particular holder, there was ample depth of lute to provide against uncupping. Although the sheeting of the holder was thin, the guides were very strong. He should not expect the lift to buckle-up and give way before the tank. He considered the joints of the tank were in accordance with the usual practice adopted. He did not think there would be any advantage in giving them greater lap. In tanks, he generally allowed $\frac{1}{4}$ inch thickness for the bottom plates; the outer ring next to the bottom curb being $\frac{5}{16}$ inch.

Any tendency to elongate or bulge in the case of the vertical plates would be communicated to the floor plates?—Yes. The bottom angle plates are what we rely upon to take off the strain—not the floor plates.

Mr. *Bell*, continuing, said that the tank was the weak part of the design. Provided there was sufficient play allowed to take up the expansion, he did not see how the guide-rollers could bind.

The INSPECTOR asked Mr. Bell to supply him with copies of the specifications relating to the tanks at Belper and Burton, which the witness promised to do.

Mr. PENDOCK pointed out that Mr. Humphrys stated at the inquest that there were 16° of frost early on the morning of the accident and the temperature in the afternoon was 60°.

Mr. *Bell* said he did not think, however, that the range of temperature would account for the accident. The wind was not considerable. He did not think the atmospheric conditions would account for the occurrence.

The TOWN CLERK said that on the night preceding the accident there was a sharp frost. It was a warm forenoon; a high wind subsequently prevailed, and afterwards there was a snowstorm.

Replying to Mr. MILWARD, witness said that, taking the tank itself, the top row of plates would have to sustain the least pressure as far as the water was concerned, but they would have to take the strain of the holder. For ordinary water pressure the lower plates of the tank were sufficient.

Mr. MILWARD: When the tank was erected the recognized standard of safety was 3·5.

Mr. *Bell* added that he thought it was unfair that contractors should be called upon to design the work and be responsible afterwards. An engineer ought to be called in.

Mr. MILWARD: It was not the fault of Messrs. Walker that this was not done. (To witness): You have known them as a firm doing excellent work?

Mr. *Bell* said that that was so. Messrs. Walker had done work for him for twenty-five years, to the extent of many thousands of pounds. The work had always been satisfactorily carried out. When he had tenders to place, Messrs. Walker were one of the firms which he always invited.

Replying to Mr. WAUGH, Mr. Bell agreed that in estimating the amounts of contracts mere money was not any guide as to the value of the materials which would be obtained. Proper examination should be made by an independent engineer before the contracts were placed. It was desirable that, in regard to materials, the British standard specification for steel of construction should be incorporated in contracts. In his opinion, plates ought to be tested at the steel-works by an independent engineer before being accepted by the contractor and passed by him.

This being all the evidence for the Corporation,

Mr. MILWARD called

Professor *Henry Adams*, M.Inst.C.E., M.Inst.M.E., Consulting Engineer (of Messrs. Henry Adams and Sons, London), who said the design of the Ilkeston holder was in accordance with the usual practice of manufacturers, and he thought the practice was a good one in this case. He was of opinion, judging from the tests made, that the plates were of good quality and of considerable uniformity. As to the factor of safety in regard to the tank, he thought sufficient allowance had been made—3·5 in the bottom tiers. Some engineers thought 3 as a factor of safety was sufficient for known constant deadloads. A higher factor was necessary at the top. He thought the provision made in this case was sufficient to resist all shocks or stresses that could be anticipated in regard to the tank. He had seen the drawing of the fracture and had a decided opinion that the rip commenced at the top. Witness, by the aid of a diagram, illustrated in considerable detail the points leading to the conclusion at which he had arrived.

Replying to the INSPECTOR, the Town Clerk said he did not know whether the plates had been preserved.

Mr. *Bell* said he had some taken to Derby for examination.

Professor *Adams* said there was nothing in the appearances to lead to the idea that the fracture commenced at the bottom. It commenced at the junction of a very stiff part with a more flexible portion in the upper part of the tank.

The INSPECTOR: That is to say, that the skin tore by the side of the stiff bracket?—Yes.

Further evidence of the witness dealt with the line of fracture. He thought that it started at the inner edge of the top curb.

The INSPECTOR asked Mr. Bell whether he agreed in that view. Mr. Bell said he did.

Professor *Adams* added that he thought it would have been a mistake to provide an increase in lap or to have given greater lap. It would have made the caulking more difficult. As to wind pressure, it was possible some addition to the stress might have been thereby occasioned, but it would be quite trifling.

Replying to Mr. WAUGH, witness said that in order for a person to notice that the holder was revolving, it must have been descending with great rapidity.

The INSPECTOR: Whether the lowering of the upper lift was caused by the jamming of the lower lift or caused by the bursting of the tank, the holder would at the beginning commence to revolve?—Yes.

Do you consider the tank was properly designed for the work it had to do?—Yes, I think it must have been something abnormal to cause the accident.

Was the tank made in accordance with what you consider a good design?—Yes.

It is a tank which you would have accepted yourself?—I might possibly have made some alterations if it had been submitted to me. When one undertakes the whole responsibility one likes to be perfectly safe. I might have wanted a little more margin at the bottom.

More margin of safety do you mean?—Yes, at the bottom; but at the same time if it were submitted to me and I was asked whether I thought it was a good design, I could not have found fault with it. If I had been asked, however, to supply a design, I might have made a little alteration at the bottom.

The INSPECTOR: You would have provided a larger factor of safety?—Yes. As the plates go by even sixteenths, it might have happened that the size selected gave rather less than 4 for a factor of safety, in which case I should have been satisfied.

In reply to further questions, witness said he agreed generally with the calculations made by Mr. Bell, there being nothing serious in them to which he would take exception. The jointing in the tank was, he thought, satisfactory. The rip was virtually from the top, and it was not due to any weakness from the reduction in the factor of safety. He agreed that in spiral holders the strength of the tank should be greater than in the case of column holders in the top curb. Except in the upper part, he did not think that in regard to spiral holders the tanks need be of any greater strength than for column holders.

Looking at the structure as a whole, what do you regard as the weakest part of the work, the holder or the tank?—I cannot see theoretically any weak part, but practically I am forced to the conclusion that, as this failure really did occur, I can only attribute it as being due to something additional to all ordinary circumstances. I think a stone thrown from the road lodging between a roller and the guide might have conduced to a jamming of the roller and the holding-up of the outer lift.

Otherwise you do not think there is any one part weaker than the other?—No.

Do you think the overhanging roller would not have been a weakness? Do you think that might have caused any extra rocking?—I think that might have been a small element additional to the other.

Witness added that he had designed many tanks—not any for gasholders throughout, but for oil and water storage. He had designed parts of tanks for column holders. Mr. Corbet Woodall consulted him professionally forty years ago with regard to the construction of one of the first large gasholders, and he had been consulted from time to time by others. He also had a small private gas-works in his charge. The largest size tank for which he had prepared designs was 110 feet. He was unable to supply particulars of the design or of any others, as clients generally took away the notes and sketches.

Mr. *R. J. Milbourne*, Assoc.M.Inst.C.E., said that he was engaged at present as Assistant-Manager to Messrs. Walker. He was not in that position, however, in 1909 when this tank was erected. With regard to the factor of safety 3·5 on the lower plate, that was the usual practice. He had had under his observation a number of large tanks. In regard to these, the same factor of safety had been allowed, and had worked out satisfactorily for the lower tier. This was the first case in which trouble had occurred. He had brought a large number of plans from the office, which he now placed at the disposal of the Inspector. The factor of safety, witness added, increased towards the top of the tank plates. The arrangement generally, he considered, was adequate to meet the strain in connection with the gasholder in this case. They were right to take into consideration not only the strength of the plates used, but the strength derived from the three angles employed. He had had many years' experience of spiral holders—in fact, ever since they were introduced. His firm had experienced the possibility of gasholders jamming through things being thrown into them. In one case, schoolboys had occasioned considerable trouble in this way; and the firm had been asked to devise a guard, but had thought there was danger in doing that. In the instance referred to, however, it was not a case of actual jamming. This was the first instance of such jamming. Their work had generally given satisfaction to gas engineers. Rollers needed constant examination and attention. It had been suggested that there should be a little more lap, but he did not think that the strength of the joint would be increased in any way

by an additional width. As this holder had been practically tested to destruction, the fracture showed conclusively that the failure had not occurred through the design of the riveted joint. They had had great quantities of plates from Messrs. Hickman, and there had never been any cause for dissatisfaction. He had examined the lifts that morning and found signs of fire as low down as the cup of the inner lift. The fire must have taken place before the bursting of the tank. Engineers as a rule would be satisfied with ¼-inch plates at the bottom. He thought the $\frac{9}{16}$-inch plates for the outer marginal row of bottom plates were ample. They still employed a factor of safety of 3·5 for the bottom plates, but more for the top curbs. That was being now generally done. He saw no reason to strengthen the bottom plates, because there was a definite strain brought upon them and not distributed from the top. If this had been a column-guided holder, they would have put in a lower angle curb. This would not have increased the thickness of the side plates. They believed that in the construction sufficient allowance was made for wind pressure. The margin of safety for the tank covered corrosion. But if tanks were properly painted there was not much danger of corrosion from below the water-level. Witness promised to supply particulars of tanks designed by the firm. Higher working stresses might be adopted by outside engineers; but as contractors were in competition with other firms, they adopted this standard of safety as sufficient. The most important thing in connection with spiral-guided holders was the strength and rigidity of the top curb of the tank.

The INSPECTOR: If the top curb was not strong enough in this case, there may be many cases in the country where the top curbs are weaker still?—Yes.

Witness, giving some details of the work, said all the rivet holes were punched. They had never had failure through rivets, and had not had in this case. The whole of the work was caulked. He thought that a ⅞-inch rivet through a $\frac{5}{16}$-inch bottom plate was safe. Ample provision was made for contraction and expansion of the gasholder. They always provided grooved rollers. These did not increase the risk of binding. The firm never had any complaint as to locking, except in a case at Merthyr Tydvil. Some adjustment was necesssary and was made there.

The INSPECTOR: I am told that rollers put in there caused jamming, and they were removed.

Witness added that in his opinion all gasholders should be inspected periodically and the rollers adjusted. This was important. After a time an adjustment of the rollers was sometimes found necessary, and this adjustment served for a considerable period.

Mr. *Humphrys* (recalled) said he had had no occasion to adjust the rollers. Nothing had been done since the holder was handed over by Messrs. Walker. Most of the debris from the tank had been sold.

John Monk, general foreman to Messrs. C. & W. Walker, in whose service he had been for forty-five years, and who had the general supervision of the erection of the Ilkeston holder, described the nature of the work, which in his opinion was well carried out. He had had the supervision of such work all over the country.

The INSPECTOR said that he did not propose at present to close the inquiry. He should adjourn it to a date convenient to the parties.

It was ultimately decided to adjourn the further proceedings until Tuesday, July 9, at the Ilkeston Town Hall. The Inspector intimated that in the event of no further evidence being then necessary the proceedings would be more or less formal. He would give an indication to those concerned of what further testimony, if any, might be needed, and in due course his report would be presented to the Home Office.

The Inspector before leaving the neighbourhood availed himself of the opportunity of paying a visit, in company with Mr. Bell, to the Langley Mill Gas-Works, where a spiral-guided holder is in use.

Cheaper Gas at Burton.

At the monthly meeting of the Burton-on-Trent Town Council, Alderman Lowe proposed the adoption of a series of reductions in the price of gas in the borough—that to the ordinary consumer being from 2s. 4d. to 2s. 2d. per 1000 cubic feet. In doing so, he said the Committee hoped at one time to bring it down to 2s.; and had it not been for the coal strike, they would have been able to do so with confidence. Personally, his own view was that the coalowners would have to ask very much less than they were doing. Consequently, he hoped the time was not far distant when the Committee would be able to come to the Council and recommend that the price of gas should be 2s. per 1000 cubic feet. When he first became Chairman of the Committee, the price was about 2s. 9d. or 3s. That day they recommended a reduction of 2d. to ordinary consumers and those using gas for power and for manufacturing purposes—such as bakers, brassfounders, tailors, laundries, printers, &c. At the present time, the latter class were charged according to a special scale which did not enable them to have any considerable reduction in price; but as it was advisable to make the charges as simple as possible, it was proposed to charge them as for power purposes. He had no doubt whatever that the finances of the Committee would justify the reduction. With regard to the prepayment consumers, they did not propose to make any reduction at present, as in 1910 they were benefited to the extent of 4d., as against the ordinary consumers' 2d. It had to be remembered that every alteration in the slot-meter price necessitated considerable cost in adjusting the meters. When the Committee came forward at the end of the year, as he hoped, with further proposals, a substantial reduction would be made to them. He had no doubt the gas consumers in the town would appreciate the concessions made by the Committee.

Reduction in Price at Bingley.—The Bingley Urban District Council have adopted a recommendation of the Committee that the price of gas be reduced 2d. per 1000 cubic feet, with a corresponding concession to slot-meter users. The reduction is to come into force on July 1; and it will make the price of gas 1s. 10d. per 1000 cubic feet, subject to discount.

SALE OF GAS-WORKS RESIDUALS IN GERMANY.

The Annual General Meeting of the Wirtschaftliche Vereinigung Deutscher Gaswerke Actien-Gesellschaft was fixed to take place, in Munich, as yesterday (Monday), when the report for the past year was to be presented, new officers elected, and more shares issued.

The Wirtschaftliche Vereinigung is a Co-Operative Society for the sale of the residual products of gas-works. The many advantages of these common sales make themselves felt more and more every year throughout the whole of Germany; and the 130 gas-works which joined in the last business year brings the total up to 308, with a yearly make of about 38,644 million cubic feet of gas. These, for convenience, are divided into three distinct groups, according to their geographical position; and to keep pace with the constantly increasing amount of business, a branch office has lately been founded in Berlin, to deal with a part of the coke sales. Contracts for the sale of bye-products have also been concluded with some seventy other gas-works, which are not actually shareholders. The export and import of coke have been regulated to a certain extent by the Society by means of contracts with the Belgian and the Paris coke syndicates; and the question of starting an export centre on the sea-coast is already under consideration. The Society also undertake the purchase of fittings, pipes, purifying materials, &c., for the members.

An idea of the amount of business done is best conveyed by quoting a few of the figures from the annual report. In 1911-12, the Society disposed of 401,282 tons of coke [the German ton is some 1·5 per cent. smaller than the English], as against:

295,809	tons in	1910–11
266,631	,,	1909–10
306,473	,,	1908–9
293,972	,,	1907–8
339,928	,,	1906–7
200,895	,,	1905–6

The quantity declared for sale by the various works for the coming year is 595,634 tons; and still more is likely to be offered during the year. Practically all this is already covered by sales contracts.

Tar prices varied considerably in different parts of the country. In all, 69,478 tons were sold, with a value of some £78,300. The demand for sulphate of ammonia for agricultural purposes was quite exceptional; and 25,110 tons were sold, with a value of about £64,900. Ammonia prices are likely to remain high.

Retort carbon to the amount of 1245 tons was sold for about £3340; and prices in the new contracts are still better. Spent oxide for blue and for sulphur also fetched good prices; and 5091 tons were sold for £3360.

LANCASTER CORPORATION GAS UNDERTAKING.

Proposal to Spend £30,000 in Extensions.

The successful character of the gas undertaking of the Lancaster Corporation was brought into prominence at the inauguration last Friday of a new three-lift gasholder at the works, which since 1880 have been under the control of Mr. Charles Armitage, Assoc.M.Inst. C.E. Opportunity was taken of the occasion to offer felicitations to Sir Norval Helme, M.P., the Chairman of the Gas Committee, upon his knighthood.

Sir Norval Helme presided at a gathering in the Manager's offices, among those present being the Mayor (Mr. Edward Caudwell), Mr. Armitage, his Assistant (Mr. H. Hoy), Mr. T. Cann Hughes, M.A., the Town Clerk, and a representative gathering of members of the Corporation.

The new holder takes the place of the old single-lift holder which was wrecked in the gale of November last year. Its capacity is 415,000 cubic feet; and it was constructed by Messrs. Clayton, Son, and Co., of Leeds, who in 1890 erected the large three-lift holder of 1,152,000 cubic feet capacity; thus giving a storage of 1,567,000 cubic feet, in place of 234,000 cubic feet, the capacity of the three small holders at the time the Corporation purchased the gas-works.

Sir NORVAL HELME said they had met to mark a further advance in the Gas Department of the Corporation. Since the Corporation acquired the undertaking of the Gas Company, the Corporation had successfully carried on the manufacture of gas, and by the skilful adaptation of improved methods had rendered great service to the ratepayers, and had provided an investment that had largely increased in value. When the Corporation purchased the gas-works in 1880, there were three small single-lift gasholders of 50, 60, and 100 feet diameter, which were capable of storing 234,000 cubic feet of gas. When the Corporation obtained possession of the works, they commenced to build a new tank, and erected an additional single-lift holder 130 feet diameter; the total cost of the tank and holder being £10,000. In 1890, the single-lift holder was enlarged to a three-lift, at an additional cost of about £8000; thus increasing its capacity to 1,152,000 cubic feet. The 50-feet and 60-feet holders were abolished, as being too small for useful service, and the 100-feet holder remained in use until last year, when, owing to the gale, it was destroyed. Mr. Armitage prepared plans and secured the erection of a new three-lift holder; and the works now supplied 1½ million cubic feet of gas in place of the 234,000 cubic feet, which was the total capacity at the time the Corporation acquired the gas undertaking. As to the capital, when the property was bought the amount expended was £87,565; and the make of gas was only 51½ million cubic feet per annum. Now the capital expenditure stood at £138,849; and the make was 220 millions. The increased expenditure during these 32 years was £51,284, and was due principally to the purchase of land, the cost of the new tank and gasholder, and the conversion of the old permanent debentures into redeemable stock, which required a nominal increase in their capital of £25,000. Through the wise policy of the Corporation in allowing the Gas Committee to use a large proportion of profits for the extension of

the works, they had been able, like a successful man of business, to develop their manufacture out of profits without going into debt and being hampered with heavy capital charges. He should like to bear his testimony to the debt they owed to Mr. Armitage for his successful management of the gas-works. Unless the Committee had been skilfully led by their Manager, they could not have had the success they had achieved under Mr. Armitage; and it had been a pleasure for successive Chairmen to be in communication with him who at all times had done his utmost to consolidate the work entrusted to them. No Corporation could be better served than they had been by their Gas Engineer. In asking the public to recognize the successful work of the Gas Department, he should like to remind them that gas which thirty years ago was sold, subject to a slight discount, at 4s. 6d. per 1000 cubic feet, was now available for lighting purposes at 1s. 11d. per 1000 cubic feet net; and the charge for gas for motive power had been brought down, so that they hoped to attract users on the low basis of 1s. per 1000 cubic feet for large quantities. The development of the treatment of residual products had enabled them to make the large profits they had realized, as his audience would understand when it was known they were getting 92 per cent. of the value of the coal back again in residuals. While building up the capital value of the gas-works, they had since 1892 contributed £35,000 in aid of the rates. Last year it was a little more than £5000—£3800 in actual cash, together with a free supply of gas, estimated at £1600 or £1700. With regard to the future, the Gas Committee had carefully thought out the necessity of providing against ordinary risks of wear and tear, and the obligation they had to maintain the public supply of gas. Without having to bring in any skilled engineers, Mr. Armitage had prepared plans which would entirely duplicate the productive power of the retorts. At present they had 192 retorts, and they were working 160 of them regularly; so that they had not a large margin for alternative use. They were working under such pressure that they had come to the time when something ought to be done to provide a margin to give perfect security for the future; and therefore, in the plans presented, they had a scheme which would, as he had said, double their producing power. These plans showed that they could fire 192 fresh retorts in another building; but having regard to the financial exigencies of the town, and recognizing the need of the Corporation to avoid the expenditure of large sums of money on capital account, the Committee had not yet adopted the plans, as they felt they should postpone the expenditure of so large a sum of money as would be necessary to bring everything up to the latest standard of efficiency. On the other hand, the time had arrived when they should carefully consider when and how they should proceed with the work. The total expenditure would amount to £30,000.

Later, in the valve-house, Sir Norval Helme asked the Mayor to turn on the gas from the new gasholder. His Worship, after doing so, expressed the pleasure it gave the members of the Corporation to be able to congratulate Sir Norval Helme and the Gas Committee upon his new dignity, and said he wished all success to the undertaking. Sir Norval briefly replied, and a number of toasts were honoured.

THE YEAR'S RESULTS AT OSSETT.

At the recent monthly meeting of the Ossett Town Council, the report of the Gas Engineer and Manager (Mr. A. E. Mottram) for the year ended March 31 was submitted. It showed that the make of gas was 128,150,000 cubic feet, of which 121,779,800 cubic feet had been sold—being an increased make of 6,200,000 cubic feet and sale of 6,796,500 cubic feet compared with the previous year. The quantity of coal carbonized was 11,413 tons, and the yield of gas 11,228 cubic feet per ton, compared with 10,927 tons and 11,160 cubic feet per ton before. The gross profit was £7642. As the interest and sinking-fund charges came to £5954, there was a balance of £1688, of which £1437 had been added to the reserve fund, and £250 to a suspense fund to meet the expenses of the Wakefield Gas Bill. The price of gas was reduced 3d. per 1000 feet to consumers from July 1 last. This concession to the consumers amounted in the nine months to £1255. The mains had been extended to Dennington; the total length now amounting to 50¾ miles. Ordinary meter consumers number 4061, and slot-meter consumers 3908—an increase of 293.

Attached to the report was an analysis showing the cost of gas per 1000 cubic feet sold last year compared with 1910-11. The gross cost was 2s. 3·93d., against 2s. 3·71d.; and the net cost, exclusive of capital charges, 1s. 4·8d., compared with 1s. 5·68d. Interest and sinking-fund charges added made the total cost of production 2s. 4·52d., against 2s. 7·21d. The receipts for gas, meter-rents, &c., averaged 2s. 7 86d., against 2s. 10·94d. before; and the instalment proposed to be added to the reserve fund was 2·82d., against 3·71d.

In moving the adoption of the minutes, the Mayor (Mr. H. Robinson) remarked that, in the past year's working, his most sanguine expectations had been exceeded. The success in every particular was without parallel in the history of the undertaking. Without hesitation or reservation, he paid his usual compliments to the Manager and his assistants, down to the humblest workman, for their intelligent conception and faithful performance of their duty, without which the results achieved could not be possible. There had been an unfortunate coal strike, which had caused them to suffer, but not to the extent that might have been expected. They had very little coal storage capacity within the works, and therefore could not provide extensively against this emergency. In addition, there was a railway blockage immediately preceding the strike, which left them less prepared than otherwise they would have been. Considering these lamentable circumstances, they were very fortunate; the only restrictions of which the public were aware being the unlit streets for five nights and a little lessened pressure in their homes, which was hardly, if at all, perceptible. The unaccounted-for gas was now down to the low figure of 4·9 per cent., which was remarkable; for the area supplied was neither compact nor always on solid ground. With regard to the sale of gas, the most pleasant feature was the increase of over 2¾ million cubic feet for engines and cookers, because this was gas which was consumed in the daytime. This was just the thing they wanted, and were bidding for —offering engines and gas-cookers on easy and advantageous terms, and gas at the low figure of 1s. 10d. per 1000 cubic feet. Referring to the Wakefield Gas Bill, and the settlement arrived at, he acknowledged the courtesy of the Chairman of the Wakefield Gas Company and of the Directors and officials, throughout the negotiations.

Numerous congratulatory speeches were made, and the minutes were adopted.

RAMSGATE GAS AND WATER ACCOUNTS.

At a recent meeting of the Ramsgate Corporation Gas and Water Committee, Alderman Coleman, the Chairman of the Accounts Committee, presented his annual report on the working of the Gas and Water Departments for the year to March 31. The portion relating to the gas undertaking was as follows.

The expenditure under capital account during the past year is heavier than for some years previous, owing to the amount spent on high-pressure mains, plant, lamps, &c.; the sum expended on these being £1627, to which has to be added £309 for new meters—making a total capital expenditure for the year of £1936. Last year the remainder of the overspent capital was paid for out of surplus profits, making a total of £4147 repaid during the past four years. The only amount of overspent capital at present is therefore the sum stated above as having been spent during the past year; and this will be referred to later. The total provided for in this year's accounts for the redemption of capital is £3315. The gas made during the past year amounted to 260,147,000 cubic feet, being an increase of 5,545,000 cubic feet, equal to 2·18 per cent., over last year. Notwithstanding the reduction of 3d. per 1000 cubic feet on gas used for power purposes, the revenue from gas sold shows an increase of £366. It will be remembered that last year the Committee decided to charge rental of cookers and gas-fires for two quarters of the year only, after they had been twelve months in use. This concession to consumers should have reduced the revenue under this head by approximately £600; but principally owing to the large number of extra cookers and fires sent out during the year, the decrease in revenue amounts only to £278. Receipts for coke and breeze show an increase of £367. Tar shows an increase of £149, and sulphate of ammonia an increase of £305—making a total increase in the sale of residual products of £821. Residuals during the past year have realized 50·38 per cent. on the cost of coal. The total increase in revenue therefore amounts to £942. Coming to the expenditure side of the revenue account, owing to the increase already mentioned in the make of gas, the majority of the items show increases, with the exception of coal, which, owing to better working, has cost less. The only large increase in the expenditure is on account of rates and taxes, amounting to £369. This represents an increased contribution from the Gas Department in aid of rates. The net increase in expenditure amounts to £770; the total revenue is £45,076; and the expenditure is £33,739—leaving a gross profit of £11,337. After paying from this amount interest on loans and income-tax, amounting to £5151, and setting aside instalment of principal already referred to of £3315, there is a net profit on the year's working of £2871, to which has to be added £671, the balance standing at the credit of the profit and loss account, making a total of £3542 available for disposal. From this available balance, I should recommend that you pay off the whole of the capital expenditure incurred during the past year, amounting to £1936; that you hand over £1000 to the district fund in aid of the next winter's rate; and that the balance, amounting to £606, be carried forward. I should also further like to recommend, as an added concession to the consumers, that meter-rents be reduced from midsummer quarter next in accordance with the schedule prepared by the Engineer (Mr. W. Thomson), which shows a total reduction of over £400 per annum. Special reference, I think, should be made to the effect on the department of the recent coal strike. While the Committee congratulate themselves on the fact that, by careful forethought and anticipation, the department was able to maintain a full supply of gas during the whole period, and at the same time came through the crisis with practically no extra cost to meet, the supply of gas for heating, cooking, lighting, and power was seriously jeopardized. It will, therefore, be essential for the Committee to give very careful consideration to whatever schemes may be brought forward to enable the department to safeguard the interests of the consumers against any similar trouble.

As to the Water Department, the income for the year amounted to £11,877, and the expenditure to £5797, leaving a gross profit of £6080. After meeting capital charges, &c., the net profit remaining was £76, to which was added the balance of £218 brought forward—making a total unappropriated profit in hand of £294.

Alderman Coleman characterized the results as very satisfactory; and he also referred to the high-pressure system—remarking that those who had had it installed were very pleased with it. The whole result of the successful year's working was due to the constant vigilant attention the Engineer had given to the works. They should feel proud to have such a man as Mr. Thomson at the head of affairs.

The report was adopted.

Bolton Water Undertaking.—The Bolton Corporation propose to spend £25,000 in connection with the water undertaking, and a Local Government Board inquiry was held last Wednesday by Mr. T. C. Ekin. Mr. Lewis Mitchell, the Water Engineer, explained that the bulk of the money was required for the construction of a main from the Sweetloves Reservoir (now out of action) to the Ferns Park pressure filters. It was intended to convert the Sweetloves Reservoir for the storage of raw water, which would be brought from the Entwistle and Delph watersheds, or from the gathering-grounds between the Dingle Reservoir and Sweetloves. To deal with this water, the Corporation had either to provide pressure filters at Sweetloves or convey the water to Ferns Bank, where there was an installation capable of dealing with the maximum consumption likely to arise within the next thirty years. The total available capacity of the Corporation's reservoirs is 1,109,000,000 gallons, which is equivalent to 162 days' supply at the present rate of consumption.

STOURBRIDGE GAS UNDERTAKING.

Annual Report and Accounts.

The Gas Engineer and Manager of the Stourbridge Urban District Council (Mr. Charles H. Webb, M.Sc.) has presented his report for the year ended the 31st of March. It shows that the sales of gas increased by 2,455,500 cubic feet. The money value of this increase is £624 2s. 4d. The coal strike which occurred during the last month of the financial year reduced the profit; but the prices realized throughout the year for all residuals were very satisfactory, and have considerably improved matters. Various other expenses were somewhat heavier during the year (such as repairs to retorts, mains, &c); the result being a gross profit of £11,366. After deducting income-tax, annual instalments, interest, &c., there remains as a surplus £2455. About 3 miles of mains were laid, and 72 ordinary and 291 prepayment meters and 326 stoves fixed. Tar dehydrating plant was erected during the year, and has, up the present, worked very satisfactorily.

The working statement shows that 231,182,000 cubic feet of gas were made; and that 206,960,600 cubic feet were sold for private and public lighting, or 89·52 per cent. of the total make, which was at the rate of 10,938 cubic feet per ton of coal carbonized. The coke and breeze made per ton of coal was 12¼ cwt.; tar, 11·85 gallons; and the sulphate made per 100 tons of coal was 14¾ cwt. The accounts (certified by Messrs. Wood, Drew, and Co.) show that the sale of gas produced £27,607; meter and stove rentals, £1282; and residuals, £10,585—making a total of £39,474. The expenditure being £28,108, the amount carried to the profit and loss account was, as stated above, £11,366. This was at the rate of 10s. 9·06d. per ton of coal carbonized and 13·18d. per 1000 cubic feet of gas sold; the surplus (£2455) being at the rate of 2s. 3·88d. per ton of coal and 2·84d. per 1000 cubic feet of gas sold.

GAS PROFITS AT HEREFORD.

In presenting the report of the Gas Committee at the last meeting of the Hereford Town Council, Alderman Witts said the gross profits of the gas-works last year amounted to £3865, against £3935 in the previous year—a decrease of £70. He thought this result was extremely satisfactory, inasmuch as the reduction in the price of gas ran over twelve months, against six months during the preceding year. He would like to point out that a reduction of 3d. per 1000 cubic feet in the price of gas to the ordinary consumers meant a loss of £1000 to the income of the Gas Committee. In past years he had repeatedly assured the Council that making reasonable reductions, when the Committee could afford it, had been the true policy to proceed upon. Of course, a reduction in price meant an increase in the consumption of gas, and in the long run it was good business. For instance, in 1903 the penny-in-the-slot system produced £1679. They reduced the price by giving additional discount, and last year the prepayment system produced £2595, an increase of nearly £1000. In 1903 they had 568 cookers out under the system, and last year the total was 1877. The net profit, after paying the sinking fund and interest, amounted to £2096. The Committee had during the year paid £528 out of the profit in purchasing cookers, so that they had not asked for a capital sum for this purpose. The gas-works had been kept in a good state of repair, and were more valuable to-day than they were some twenty years ago. The cost of repairs also came out of revenue, and as long as the present Committee were responsible this policy would be pursued. He did not disguise from the Council that nearly everything had been in favour of the Committee during the past year. Over the past few years, he considered £300 had been saved each year by carefully looking after leakages. As to penny-in-the-slot gas-fires and cookers, last year the Committee put out 380 extra cookers. This was a source from which they were deriving a good income. In conclusion, he desired to acknowledge the services of Mr. W. W. Townsend, the Manager. He was sure no city could be better served than Hereford was by Mr. Townsend.

Mr. Parlby said, looking over the past thirty years, and the difficulties experienced at intervals owing to strikes among the miners, &c., he thought the Gas Committee and the Gas Engineer were entitled to an expression of the Council's appreciation for their foresight in laying in a large stock of coal in anticipation of the recent crisis in the coal trade. He also referred to the fact that the slot consumers were increasing, and now numbered 2595, as against 1925 ordinary consumers. It was an interesting fact to the citizens that the gas consumed by the slot customers now reached nearly 29 million cubic feet, which was more than half the quantity of gas sold. This development was particularly gratifying, because it had all been brought about during the last thirteen years, or since the establishment of the electric light works. The Mayor remarked that he could quite understand the pride which Mr. Parlby took in the success of his child—the slot-meter system—and he would like the Council to associate with him the name of the gentleman who introduced the system on Mr. Parlby's advice—the late Mr. Philip Ralph.

BURNLEY CORPORATION GAS UNDERTAKING.

The Engineer's Annual Report.

The report of the Gas Engineer (Mr. J. P. Leather) to the Burnley Corporation Gas Committee, for the year to March 31 last, contains the following information.

There was an increase of 28,795,000 cubic feet, or 3·81 per cent., in the make of gas compared with the preceding year, when the increase was 9·04 per cent. The total make was 783,979,000 cubic feet, apportioned as follows: Sold, 678,140,757 cubic feet; consumed in the public lamps, 56,833,400 cubic feet; used on the works, 9,161,500 cubic feet; unaccounted for, 39,843,343 cubic feet (5·08 per cent. on the make). There are now 2904 public lamps in the borough, or 70 more than at the close of the year 1910-11. The amount receivable for gas sold by meter (less discounts, allowances, and irrecoverables) was £72,921. Of the 783,979,000 cubic feet of gas made, 233,046,000 cubic feet, or 29·7 per cent., was oil gas. In the production of coal gas, 48,976 tons of coal were carbonized. This works out to 11,249 cubic feet per ton, compared with 10,904 cubic feet before. For making the oil gas, 598,263 gallons of oil were used, or 2·56 gallons per 1000 cubic feet, against 2·54 gallons before. The average illuminating power of the gas supplied was 18·36 candles.

There was a decrease of 109 in the number of ordinary meters in use, and an increase of 558 in the prepayment meters. The total number of meters in use now is 27,289, of which 14,462, or 53 per cent., are of the prepayment class. The amount of money collected from the prepayment meters was £27,939 4s. 11d., which corresponds to 223,941,357 cubic feet of gas. The average number of these meters in use at one time was about 14,200; the average annual consumption of gas per meter, therefore, was 15,770 cubic feet. In 1910-11, the average was only 14,680 cubic feet. There are now 11,379 small breakfast cookers in use with prepayment meters. The business done in the gas-stove department during the year was as follows: 96 cookers and 93 gas-fires were sold direct, and 519 cookers and 3 gas-fires were fixed on the hire-purchase system. The number of cookers on simple hire is 18 less, and of gas-fires 12 less, than reported last year.

Mr. Leather gives the following table showing the total amount of business done since the Gas Committee commenced to let stoves on hire:—

	Cooking-Stoves.	Gas-Fires.	Total.
Sold direct since May, 1883 . .	2,137 ..	2071 ..	4,208
Sold on hire-purchase (purchase completed)	6,204 ..	440 ..	6,644
Do. (purchase not completed) . .	2,237 ..	103 ..	2,340
Now on hire	288 ..	135 ..	423
Total	10,866 ..	2749 ..	13,615

The total length of mains laid in the twelve months covered by the report was 7559 yards, and 388 yards were taken up; making a net increase of 7171 yards. There were 504 services laid to new property during the year.

MORECAMBE GAS UNDERTAKING.

In moving the adoption of the Gas Committee's minutes at the monthly meeting of the Morecambe Town Council, Mr. Gorton said last year he had the pleasure of announcing a fairly large profit, and this year again he thought they had every reason for congratulation. When the Council bought the gas-works in 1901, the outlook was gloomy. The gross capital was £169,561, and before 1908 it was increased to £185,382. Since then it had been gradually reduced, and now stood at £152,262. It was very satisfactory that, with such a load of debt, they had been able to work the concern so successfully. In 1901-2 the gas sold amounted to 69 million cubic feet; while for the year just closed the sales totalled 82 millions, a big increase, which showed that the town was improving in more ways than one. The first slot-meter was fixed in June, 1901, but by the end of the following year they had fixed 531 slot-meters, which produced a revenue of £471. At the end of the last financial year, they had fixed 2555 of these meters; the revenue from them being £6257, or £4 more than the revenue from ordinary meters. In the gloomy times from 1901 to 1908, they had a total deficit of £8941. They made their first profit, £72, in 1909-10. In 1910-11 the profit increased to £1827; and last year it was £1686. If they could go on making a profit to this extent, they would have every reason to be satisfied. The profit of £72 in 1909-10 was put to the district fund account. Out of the profit of £1827 in 1910-11, £1200 was put to the same account; and out of the profit of £1686 last year, £800 went to the district fund—a total of £2072, which had gone to the reduction of the deficit from £8941 to £6869. In his opinion, as an old member of the Committee, before they reduced the price of gas to the consumers, it was their duty to try and wipe out this deficit, and thus put the department upon a sound basis. The total income for the year was £19,667, and the working expenses £8662, leaving a gross profit, with bank interest, of £11,071. They had paid in principal and interest £9384, in addition to £529 out of revenue in repairs and renewals. The Committee proposed to erect a new sulphate house and plant, which would produce at least £200 more profit in the department. Coal had cost them nearly £500 more than in the previous year, but they had made more gas. He paid a tribute to the Committee, and also complimented the Gas Manager (Mr. C. R. Armitage) upon the successful way he had conducted the works since he came to Morecambe.

In his report on the year's working, Mr. Armitage says there are now 2230 ordinary consumers and 2555 prepayment consumers on the books. The total quantity of gas made during the year to March 31 was 91,905,000 cubic feet, as against 89,600,000 cubic feet for the previous year—an increase of 2·51 per cent. The gas made per ton of coal carbonized was 11,513 cubic feet, as against 11,923 feet for the previous year. The quantity of gas sent out from the works was 82,417,800 cubic feet, as compared with 80,967,800 feet—an increase of 1·76 per cent.

The Baths Committee of the Westminster City Council say they have had under consideration a report from the City Engineer on a proposal to substitute incandescent gas for the existing electric light in the first-class swimming bath in Marshall Street. The Engineer proposes to fix six two-light and one one-light inverted lamps, all with parabolic reflectors, and also two inverted bracket burners and globes. The estimated cost of this installation, the Committee state, is £15 10s., and the power of the light given would be between 800 and 900 candles. The Committee have decided to carry out the proposal; and an agreement is to be entered into with the Gaslight and Coke Company to maintain the burners and fittings for 21s. a quarter.

THE LIGHTING OF WORKHOUSES.

Coal Gas v. Petrol Air Gas.

In view of the efforts which, it seems, are being made in various quarters to secure the lighting of Union houses with petrol air gas, some reference may be made to correspondence that has taken place between the Romford Gas Company and the Guardians of Romford Union.

In the first letter, Mr. W. D. Child, the Engineer and Manager of the Gas Company, pointed out that in February, 1909, the Directors offered that, provided the Guardians would light the whole of the Union buildings with coal gas, a discount of 10 per cent. would be allowed from the then current price of 3s. 4d. per 1000 cubic feet. Since that time a reduction of 1d. has been made, so that, with the discount of 10 per cent., the price would be less than 3s. per 1000 cubic feet. This offer was declined, and ultimately lighting by petrol gas was adopted. Mr. Child continued: "No opportunity has been afforded the Gas Company of showing the comparative efficiency and cost of coal gas as compared with petrol gas. Some loss must have been made in lighting this portion of the Union buildings, as it is well known that petrol gas cannot be produced and utilized for lighting purposes so economically as 15-candle coal gas at 3s. per 1000 cubic feet, while for heating purposes it is almost valueless. The remark would apply to petrol gas when petrol could be purchased at 1s. per gallon; but now that the price has advanced to 1s. 6d. per gallon, with every indication that the higher price will be maintained, the comparison is still more favourable to coal gas. The Directors are not aware that any cause for complaint respecting the coal gas has at any time arisen. As one of the largest ratepayers in the district, and being interested in the supply of gas, the Directors of the Gas Company feel that they are justified in asking upon what grounds so extended a trial of petrol lighting has been carried on, and why they should be called upon to contribute in rates towards so expensive an experiment in opposition to their own business. If any really fair competitive scheme of lighting as between coal gas and petrol gas can be arranged, the Gas Company would not fear the result."

Regarding this letter, the Building Committee reported that the offer of discount by the Company was declined because it was conditional on the lighting of the whole of the buildings being by coal gas, whereas the Guardians at that time were testing two systems of petrol gas. They stated that a fair trial had been given to both coal gas and petrol gas—the lighting of the new buildings by the latter method being entirely satisfactory. As to the suggested loss on lighting by petrol gas, the following report of the Master was quoted, as showing the cost of lighting for the past three years by both coal gas and petrol gas:—

Cost of Lighting by Coal and Petrol Gas.

	£	s.	d.
Coal gas, three years ending Christmas, 1911. .	1,065	15	0
Petrol gas ,, ,, ,, ,, ,, . .	133	6	1
(Including 50 per cent. cost of installation.)			
Average cost of coal gas per year, £355 5s. No. of points, 579, cost each	0	12	3
Average cost of petrol gas per year, £44 8s. 8d. No. of points, 154, cost each	0	5	9
Difference per point	0	6	6
Cost difference 579 points, at 6s. 6d.	188	3	6
Difference on three years coal gas	564	10	6
Cost of mantles (three years), coal gas, 133½ dozen	18	19	7
,, ,, ,, ,, petrol gas, 106 dozen	17	12	9

It was added that the petrol gas had been used for heating and cooking, with satisfactory results; and that the contract price for petrol was at present 9½d. per gallon.

In the course of his reply, Mr. Child said: The report from the Master to the Building Committee, showing the cost of lighting during the past three years by both coal and petrol gas, cannot be accepted as proving anything as to the relative values of lighting by these methods for reasons that will be stated. When comparisons are made as to the relative value of systems of lighting, accuracy should be observed in noting the purposes for which the different gases are used, and the periods of time over which the use of the different burners extended. In the cases quoted by the Master, they are very dissimilar. The Gas Company have practically no opportunity of knowing how the gas supplied by them is used, and are, therefore, without correct information upon the following points: (*a*) How much coal gas is used for cooking. (*b*) How much coal gas is used for heating. (*c*) How much coal gas is used for lighting.

The coal gas supplied to the Union premises passes through four meters in connection with the old Union House, the Infirmary block, the casual ward, and the Nurses' Home; and these several supplies are connected to appliances other than those used for lighting—namely, for cooking, laundry work, heating, &c.—and in the old Union House a number of flat-flame burners are still in use. The inclusion of gas used for cooking and heating, and its wasteful use in flat-flame burners, in estimating the value of coal-gas lighting, utterly destroys the value of the calculations submitted by the Master, in which he places the cost per burner per annum at—

12s. 3d. per burner for coal gas.
5s. 9d. per burner for petrol gas.

In the Infirmary wards, some of the lights are burning very long hours—practically through the entire night and until daybreak in the morning—in winter averaging 14 hours per diem. Yet the figures just quoted are obtained by comparing the coal-gas burners with burners using petrol gas during very limited hours of lighting. Viewing the report of the Master as that of an impartial official imparting information to the Board of Guardians, it can only be looked upon as a great oversight on his part.

The number of points of supply is given for coal gas as 579; and it may be assumed that these include such points as are connected to the cooking-stove, laundry-iron heaters, &c., and works out at 12s. 3d. per point. The number of petrol burners is given by the Master's report as 154. Of their arrangement we have no accurate knowledge, and will, therefore, surmise that about 70 burners are fixed in the Board-room and offices and the remainder (84) in the wards. Allowing 30 burners for the Board-room, this number may be said to be lighted for only a few hours weekly during the winter season, and during the rest of the year not at all. The lights in the offices will be used only during ordinary business hours, and are practically done with by 6 p.m. The greater number of the lights in the wards are extinguished about 8 p.m., only a very few burners being in use during the night. In the depth of winter many of the coal-gas burners are, as previously stated, in use 14 to 16 hours per day, while the petrol-gas burners in the offices would be burning only about four hours daily, those in the Board-room a few hours weekly, and in the wards only a few burners would be in use all night.

For the reasons stated, the Board will see that the calculations put before them by the Master do not constitute a fair comparison, and that the estimated saving is erroneous. If the figures given by the Master are correct, he would be obtaining results far in excess of anything claimed by the exponents of petrol lighting.

Mr. Henry O'Connor, Fellow of the Royal Society, in his work on "Petrol Air Gas," written to help those who are proposing to use such an installation, says: "Air gas made from a gallon of petrol gives 427 candle-hours for a penny. Coal gas at 3s. per 1000 cubic feet gives 555 candle-hours for a penny, so that the cost of petrol air gas may be said to equal coal gas at 3s. 11d. per 1000 cubic feet—in round figures, 4s. per 1000 cubic feet."

Another authority, Mr. E. Scott-Snell, in a paper read before the Society of Engineers, says: "With petrol of ·680 sp. gr. (this cannot now be obtained), and a calorific value of 19,000 B.Th.U., there was a value of 132,600 B.Th.U. for 10d. net, and from this it could be calculated that 1000 candle-power hours were obtained for 2·17d. Then, assuming an efficiency of 20 candles per cubic foot with coal gas at 3s. per 1000 cubic feet, there would be 1000 candle-power hours for 1·8d. From this it would be seen that, light for light, petrol gas was equivalent in this case to coal gas at 3s. 7½d. per 1000 cubic feet."

Heating Value—Authority, E. Scott-Snell.—One gallon of petrol contains 132,000 B.Th.U., or a calorific value of about 100 B.Th.U. per foot, and gives a lighting value, when burnt, of 5 candles per foot. Coal gas has an average value of 600 B.Th.U. per foot, and a lighting value of 20 candles per foot, when burnt at low pressure with a mantle. The British thermal unit is the amount of heat required to raise 1 lb. of water 1° Fahr. Ten cubic feet of petrol gas will give 50 candles per hour; and this may be obtained with 2 cubic feet of coal gas.

The Master places the number of mantles at 1602 for coal gas for three years, equal to 520 per annum, or about one mantle per burner per annum. For petrol gas 1272 were used in three years, equal to 424 per annum, or nearly three mantles per burner per annum, though the number of lighting hours is very low.

The Master places the cost of lighting the 154 burners with petrol gas during three years at £133 6s. 1d., including 50 per cent. of the cost of the petrol installation. Assuming that the latter may have amounted to £100, and that half the amount is to be deducted from the cost of lighting as given above, this reduces the amount to £83 6s. 1d. for three years, or £27 15s. 4d. per annum for petrol light.

The cost of coal gas for the same period—1909, 1910, 1911—is placed at £1065 15s. The Company's books show the total amount for that period, including the gas used in nine Scattered Homes, as £1069 8s. 5d.; and upon this amount the Guardians would have been entitled to receive 10 per cent. discount had they accepted the offer of the Gas Company—the discount so obtained amounting to £108 18s. 10d., or an average of £35 12s. 11d. per annum.

Mr. W. Key, of Glasgow, the maker of the "Centenary" air-gas plant, allows 2½d. per 1000 cubic feet for interest and depreciation. If to this be added 9½d. per gallon for the cost of petrol, and a small amount for labour, the cost will work out at over 1s. per 1000 cubic feet; and taking the value of petrol gas (98 per cent. air) at one-fourth the value of coal gas, their respective values are:

Petrol gas.	4s.
Coal gas	3s.

After a further report by the Building Committee, Mr. Child wrote another letter from which some extracts are taken.

The Master's report places the cost of petrol gas for three years at £133 6s. 1d.; and these figures give the following result:—

	£	s.	d.
Petrol air gas for three years	133	6	1
Less 50 per cent. of the cost of plant, say . . .	50	0	0
	83	6	1
Less cost of mantles, as per Master's statement .	17	12	9
Net cost of petrol air gas (three years)	65	13	4

Allowing 1s. per 1000 cubic feet—*i.e.*, the approximate cost of petrol air gas—the £65 13s. 4d. would provide 1,313,000 cubic feet of gas, which quantity, divided by five, gives the equivalent of coal gas as 262,600 cubic feet, which, at 3s. per 1000 cubic feet, would have been supplied to the Guardians for £39 7s. 8d. When coal gas is burned in an incandescent burner, it is necessary to supply 5½ to 6 volumes of air to 1 of gas, to provide oxygen for the proper combustion of the gas. Petrol gas made with 98½ per cent. of air to 1½ per cent. of petrol vapour contains all the air necessary for combustion; but it is therefore necessary to use five times the quantity of petrol gas as compared with the quantity that would be required for each burner in the case of coal gas.

The quantity of coal gas supplied to the Institution during the three years ended Christmas, 1911, was 6,210,200 cubic feet; and if this quantity is divided by 579, the number of burners in use, it gives 10,725 cubic feet as the consumption per burner in three years, or 3575 cubic feet per burner per annum, and shows the lighting hours to average 896. Dealing with the petrol gas in the same way, it is calculated that the

quantity of gas made in the three years was 1,313,000 cubic feet, and divided by 154, the number of burners, gives 8526 cubic feet for three years, or 2842 cubic feet per burner per annum, equal to 355 lighting hours.

This serves to show how the Master's figure of 5s. 9d. per petrol-gas burner. against 12s. 3d. per coal-gas burner, has been arrived at.

SLOUGH WATER-WORKS ARBITRATION.

The Award.

An Extraordinary Meeting of the Slough Urban District Council was held last Tuesday to receive and consider the award of the Umpire (Mr. A. J. Ram, K.C.) in the recent water-works purchase arbitration, the proceedings in which extended over six days, as reported in the numbers of the "JOURNAL" for March 12, 19, and 26 last. The Arbitrators were Mr. John E. Willcox, for the Council, and Mr. Charles Hawksley, for the Company.

The Clerk (Mr. G. H. Charsley) read the award, which fixed the purchase price at £90,623 12s. The Chairman (Mr. A. Woolsey) said he thought they might congratulate themselves, and also the ratepayers, on the very satisfactory figures which had been placed before them in the award—especially when it was borne in mind that in the arbitration the Company asked for £111,477. In answer to questions, he added that the figures suggested on behalf of the Council were about £84,000, *plus* the debentures of £5000—making a total of £89,000. The Clerk pointed out that the award was the gross sum for the whole thing, and included the perpetual debentures. It did not, however, include the cost of the parliamentary proceedings and of the arbitration. Sir W. B. Keen, who had been engaged as Accountant by the Council, wrote that, in his opinion, there should be no difficulty in carrying on the undertaking without involving any charge upon the rates. The Clerk also read letters from Mr. Ram giving his charges as £247 7s. 6d., and from Messrs. Willcox and Hawksley stating their charges at £315 each—making a total of £877 7s. 6d., which the Council had to pay for the award.

After some discussion, it was agreed to adopt the award, and to call another meeting when the Clerk had received the whole of the accounts, so as to be in a position to know exactly the amount of the loan to be raised.

AUSTRALIAN GOVERNMENT AND THE GAS-WORKS.

Property to be Acquired.

It may be remembered that in the report of the proceedings at the half-yearly meeting of the Australian Gas Company which appeared in the "JOURNAL" for the 5th of March (p. 677), it was stated that negotiations had been in progress between the Government and the Company for the acquisition of the head station of the latter, in order to allow of the carrying out of improvements in connection with Darling Harbour. The Government have property on each side of the gas-works; and it was considered that if these could be acquired, traffic to and from the harbour would be greatly facilitated. The negotiations have been going on for several years, but with some activity for upwards of twelve months; and at a special meeting of the Cabinet held on the 20th ult. a decision to purchase was come to. The acquisition of the property will set free a very desirable area of water frontage. About 2000 feet of added wharfage can be provided upon it, which the Harbour Trust estimated four years ago would give an immediate return of £15,000 per annum—a revenue which it was thought would increase substantially in the near future. When the Company were approached on the subject some time ago, they asked £750,000 for their property. On the other side, it was estimated that, making due allowance for disturbance of business and so forth, a fair price would be from £300,000 to £400,000. The Directors of the Company were not unwilling to hand over their property—of course, on terms, recognizing its value from the Government standpoint; and an agreement was arrived at on the basis of a private purchase. The Cabinet, however, declined to consider any question of private bargain; and the decision they have come to is on the understanding that the purchase price shall be fixed by an arbitrator. It will be impossible for the Company to move for a considerable period; but the plant will probably be transferred to Mortlake, and the supply of gas furnished entirely from that station. Judging from the opinions expressed by the local Press, the acquisition of the gas-works by the Government was an absolute necessity. The "Sydney Daily Telegraph" said: "No doubt the Company should have been moved out of the district long ago; for, making every allowance for all the circumstances, its industry is not one that need be conducted nowadays within the city, much less in the midst of the shipping. The obvious difficulty, however, was that the Company had been planted there, and the city had grown round it. As things are now, it will retire to more suitable headquarters, and shipping traffic by land and water will be substantially convenienced."

Reduction in Price at St. Ives (Cornwall).—The St. Ives Town Council have decided to reduce the price of gas from 5s. 3d. to 4s. 9d. per 1000 cubic feet.

The Lighting Question at Biddulph.—At an adjourned special meeting of the Biddulph Urban District Council, consideration was given to a report prepared by Mr. J. H. Brearley, who had been called in to value the gas-works and report upon the commercial prospects of purchase and the extensions necessary. There are also electricity proposals "in the air," and the councillors are at variance in their opinions. As a further step, they decided that the main features of Mr. Brearley's report should be published, so as to enable the public to grasp the principal facts of the scheme, and that meanwhile the meeting should be again adjourned.

LIMITATION OF RATE-RELIEF FROM TRADING PROFITS.

From an Electrician's Point of View.

The Seventeenth Annual Convention of the Incorporated Municipal Electrical Association was held at Harrogate last week; and among the papers of more general interest read was one by Mr. S. L. PEARCE, the Chief Electrical Engineer of the Manchester Corporation, in which he emphasized the need which exists for a definite pronouncement from Parliament as to the extent to which local authorities should be permitted to relieve the rates from the profits of their trading departments. For the following abstract of the paper, and the notes on the discussion to which it gave rise, we are indebted to our contemporary, the "Electrician."

The most important argument usually advanced in advocacy of rate-relief is that the credit of the ratepayers being pledged for the trading undertakings, the ratepayers are in the position of underwriters; and, as such, bearing the risk of any losses that may be made by the undertakings, they are entitled to some return for their services. Experience has shown, however, that the risks of losses on well-established supply undertakings are slight. In any case it is surely absurd to spend the premium which, if the underwriting risk be a real one, ought to be set aside to meet the loss. It will not be seriously contested that the proper safeguards to employ to conserve the ratepayers' interest should be more adequate reserve funds, in addition to the statutory sinking funds. The author admits that when an undertaking in the first few years of its existence has made losses which have fallen on the rates, these losses should be liquidated as and when profits are available, in addition to such reasonable annual return as may be made to the ratepayers. Seeing, however, that local authorities undoubtedly raise money more cheaply than companies do, it may be asked: Is there any valid reason why the extent of advantage measured by credit should not be accepted as the full measure of rate-relief?

Next, and of much less importance, are the arguments that trading departments enjoy the almost unrestricted use of the highways for distributing mains; that the users of the commodities, being only a small percentage of the general body of ratepayers, are, when supplied at cost, obtaining benefits at the expense of the larger body; and that representatives of the ratepayers are not sent to the council to give their time to consumers but to ratepayers. Against these, may be put the fact that the main object of municipal trading is the general convenience of the public. Though electric and gas supplies cannot be put on quite the same plane as domestic water supplies, yet they bear a very close analogy thereto. All, in the present standard of life, have become, or are fast becoming, regarded by townspeople as necessities.

A further argument used is that absence of profit-making leads to mismanagement. It is difficult to follow the reasoning on which this argument is based. Competition for light and power must necessarily be keen, which in itself is an incentive to economy. A low tariff is still the best stimulus for sales; and, subject to placing the finances of the undertaking on the soundest possible footing, sums of money released from excessive contributions to rate-aid would certainly go towards reducing tariffs.

The final argument used is that it is undesirable for any community to use its credit to cheapen those commodities which come within the sphere of municipal trading. If the total charges for loan interest and ratepayer's underwriting premium equal the charges which would have to be met by private enterprise, then municipal and private trading are on the same economic footing.

As a fair market price, it seems impossible to justify charging consumers with more than the following, the total of which would probably equal, if not exceed, the price which would satisfy joint-stock companies working under leases from local authorities: (*a*) Production, distribution, and management costs; (*b*) debt redemption charges, supplementing these where necessary to make them equivalent to true depreciation; (*c*) interest charges; (*d*) underwriting charges (relief of rates) at 1 to 1¼ per cent.

Under private enterprise, the whole of the interest and underwriting charges would be available as dividends for shareholders, and would yield a steady annual return of 5 per cent., with security at least equal to the best class of industrial undertakings in the country.

Presumably, the keenest advocates of rate-relief would not urge that consumers should be worse off under municipal than under private trading. If this were the case, municipalities would certainly be unable to resist the encroachments of the large power companies, such as they have had to do from time to time.

The recent declarations of Parliament are of great interest; and as the decisions of the two Houses are opposed to what may be termed the prevailing practice, they afford some hope that the permissive powers conferred upon local authorities by section 7 of the Electric Lighting (Clauses) Act, 1899, may at no very distant date be reviewed and a statutory limitation of profits be imposed.

In the case of the Salford Corporation Bill of 1909, the House of Lords Committee proposed to limit the application of gas profits for rate-relief to 1 per cent. on the outstanding mortgage debt. It is of interest to note the form in which the Committee's decision was drawn. The Corporation were to be allowed to charge only a sum which would fall under the following headings: (*a*) A fair price for their commodity; (*b*) interest and sinking fund on the outstanding capital of the undertaking; (*c*) a share of a proper reserve; and (*d*) 1 per cent. on the capital outstanding. The Bill was withdrawn by the Salford Corporation. Recent developments in this matter have been that the districts affected outside Salford sought parliamentary powers to enforce the limitation on Salford; but later on they agreed with the Corporation to request the Local Government Board to hold a local inquiry on the question. At the inquiry the outside districts agreed, subject to the approval of the Board, that the profits to be used for rate-relief should be limited to £10,000 per annum, instead of between £5000 and £6000 under the House of Lords decision, and instead of £20,000 as claimed by Salford. On these terms, the opposition of the outside districts to the Salford Bill of 1912 would be withdrawn.

While not agreeing with the proposals, the Salford Corporation undertook to abide by the decision of the Local Government Board in the matter.

The next example is that of the Glasgow Bill before the House of Commons Committee at a later date, when the Committee refused to recognize the right, and prohibited any profit being applied to rate-relief—thus keeping in line with the general Scotch Law regarding gas and other undertakings.

A further example, and one possibly more important still, as indicating the Local Government Board's present attitude, is the Potteries' Federation Act, under which no trading profits are to be devoted to rate-relief. As is well known, the President of the Local Government Board took particular interest in the passing of this Act.

Another contentious point that arises out of these decisions is whether the benefit, if any, to accrue to the ratepayers, should be calculated on the outstanding mortgage debt, or on the total capital outlay to date of any undertaking. As far as the assets of any form of municipal enterprise are concerned, clearly the risk, whatever it may be, can only apply to the portion as yet unliquidated by the operations of the sinking fund; and the measure of benefit to be returned to the ratepayers must be determined on the basis of the outstanding mortgage debt.

It is unfortunate that on the subject of profits from public services, the State itself is somewhat inconsistent; for the postal service yields a handsome surplus to the Exchequer, while the telegraph service is conducted at a loss.

Economists in general do not regard municipal electric and gas supplies as fit subjects for any beyond the slightest taxation. Obviously there is no justification for indirect taxation upon one part of the community as a means of affording relief to the direct rating of the whole community. There is, however, conclusive evidence that such indirect taxation is being unduly imposed on consumers.

Both the "Municipal Journal" and the "Accountant" observe: "Corporations which insist upon reducing rates out of profits prevent the focussing of public attention upon the rapidly-rising general rates; and to the extent to which this is done, Imperial contributions are withheld and the reform of local taxation delayed." The main force compelling local authorities to take up this attitude towards municipal trading is apparently the necessity for meeting the cost of ever-increasing duties imposed on them by Parliament without a corresponding increase of Imperial contributions.

The results of establishing a rational system of rate-aid would be that trading committees would be under little temptation to neglect the provision of proper reserve and renewals funds, and there would be no restriction of sales.

There is another aspect of this question which is now receiving more of the attention it deserves, and refers to both electric and gas supplies. The author alludes to the indirect, but none the less effectual, obstacle which the system of extensive grants for rate-aid places in the way of abatement of the smoke nuisance. The author here emphasizes the invaluable, though indirect, benefits afforded to the ratepayers and citizens generally by a progressive policy of catering for power-loads at low rates, consistent with the financial stability of the undertakings. These benefits are: (1) The retention within the city boundaries of large industrial concerns with the accompanying retention of rateable values; (2) the retention or increase of employment; and (3) the probability, amounting almost to a certainty, that new industries will be attracted to the locality.

There are some who, in addition to advocating substantial rate-aid, urge that the proper policy is not only to render their undertakings free from all debt in the first cycle of the working "life" of the undertaking, but also to provide moneys so as to present their successors with entirely new assets to begin another cycle. This policy is evidently not applicable to electric supply undertakings, and is obviously unfair to the present generation. Entire supersession takes a long time; and such "self-capitalization" is quite unnecessary if not indeed contrary to the intentions of Parliament, which allows large re-borrowing powers to all municipalities.

What, however, is not equitable on the large scale may be welcomed in a small way. Thus, the action of the Local Government Board in recent years, in advocating or compelling the purchase of services, meters, instruments, tools, spare parts, &c., out of revenue, instead of raising loan moneys therefor, may be welcomed. The author considers this is in the direct interests of supply undertakings; and in the absence of other checks, it helps to prevent the undue burdening of trading departments for rate-aid.

Gas undertakings have been established for very much longer periods than electrical supply undertakings, with the result that in many instances they have not only accumulated large reserves during the years when competition was non-existent, but they are now enjoying the benefits of "freed" capital on which there is no burden for interest, which in itself may be sufficient to earn the amount exacted in aid of the rates. Electricity undertakings are not in this happy position; and the burden of an excessive contribution for relief of rates must, therefore, press all the more hardly on them.

In conclusion, the author endorses the suggestion made in various quarters that the matter is worthy of consideration at the hands of a Royal Commission. Alternatively, he would ask why should not the Government refer it to the Special Committee now deliberating upon the Relation and Incidence of Imperial and Local Taxation. He also hopes that the Association will take up the limitation of rate-relief; and he looks for the co-operation of the Institution of Electrical Engineers.

Alderman BROWN (the Chairman of the Leeds Electricity Committee) opened the discussion. He said those interested in municipal undertakings looked upon surpluses from different standpoints—some said all the surpluses belonged to those who made them, and that the municipality had no right to charge people more for what they received in the way of gas, electricity, or even tram-rides, than what they cost to produce.

Alderman BRUCE (Sunderland) said he agreed with the author as to the policy of the reduction of charges out of profits before allocating any to reduction of rates; but he did not agree with the methods the author wished to adopt—that Parliament should fix the amount of the contribution to the rates from trading profits. The paper was a declaration that local authorities, as such, were not fitted to carry on the business with which they were entrusted. If Parliament were to do what the author suggested, why should they not also ask Parliament to fix tariffs, operating costs, &c.? The author said it would not be seriously contested that the proper safeguards to preserve the ratepayers' interests should be more adequate. He (the speaker) agreed that, as a matter of policy, there should be a renewals fund for unforeseen difficulties with regard to replacing plant where the loan for the plant had not run out; but he objected to building up a renewals fund to provide a future generation not only with an up-to-date workable undertaking, but also sufficient funds to create another new undertaking if they so desired. The paper also said "the ratepayers are consuming what ought to be available for the ratepayers twenty years hence." He took exception to this. It was unquestionable that the future generation would be much better off than the present—being provided with more reliable, better, and more easily-managed plant, enabling the authority to supply at prices vastly lower than the present prices, and in addition the consuming devices would enable a given amount of electricity to do considerably more work. Instead of going to Parliament, he preferred to remit the matter to a Special Committee to say to what extent profits should be used on behalf of corporations.

Bailie SMITH (Glasgow) said that tramways were referred to in the paper; but these were on a different footing to gas and electricity. At the end of a year one could fix the charges for gas or electricity according to the balance; but in tramways the stage of 2 miles for 1d. could not be altered to 1½ or 2½ miles, and it might be right to use any slight surplus for any public purpose. But gas and electricity were sold in Glasgow at cost price, and nearly every ratepayer in a large city used gas, and they hoped that nearly every ratepayer would in future use electricity. Therefore the charges should be fixed according to the profits of the previous year. With regard to paying a rent for the streets, the Post Office used the streets more than they did themselves in some cases; and they did not pay a penny. The result of charging prices producing profits from a man using gas or electricity, and keeping the air pure, was penalizing him to the extent of the excess he had to pay over a man who was pouring out smoke from his chimneys.

Bailie STEVENSON (Lord Provost of Edinburgh) said he was not only in favour of limitation, but of the elimination altogether of the policy of relieving the general ratepayers at the expense of the electric light consumers. During the past eight years in Edinburgh they had contributed £49,000 to relief of rates. Year after year the Electric Lighting Committee had recommended that either the money should go to build up a reserve fund or to create a reserve for depreciation; and the temptation had always been too strong for the Council. As long as this was one of the options allowed town councils under the Electric Lighting Acts, so long would this policy be continued. They did not like going to their constituents in November and saying "there is going to be a rise in the rates." It was unfair to the consumer and to the electric lighting undertaking. The Edinburgh electric lighting undertaking would compare with any other in the country. Their capital expenditure was £1,000,000, of which £400,000 had been repaid; the reserve fund was up to its full quota of 10 per cent. on the gross capital expenditure—viz., £100,000; and, in addition to this, they recently reduced the equated period in which they were paying off their debts from 20 to 25 years. Sir Alexander Kennedy had said, although they had their reserve up to its maximum, in view of the uncertainty of the life of certain portions of the plant, and particularly of the durability of the insulation of mains, it would only be a reasonable precaution to form a depreciation fund in addition to the reserve fund. This object had been frustrated by the action of the Council in taking the surpluses for relieving the rates; and as long as the law remained in its present state, the Council would never make the attempt. He had adopted the principle advocated by Alderman Bruce; and last year they estimated for a surplus of £400 on an annual revenue of £135,000. Mr. Pearce said electric lighting concerns were financed on the credit of the rates. It was not usually put in this way. He was always told the ratepayers provided the money; but his answer was that this was not true—they were in the position of guarantors, and their liability had never been called upon, and the best security they could have that it never would was to have a large reserve fund, and utilize all extra surpluses in strengthening the financial position of the undertaking. He could not conceive of anything more calculated to impede progress among prospective users than the knowledge that they would be called upon to pay an enhanced price towards lowering the municipal rates of some person who did not use electricity. The only sound policy with all municipal undertakings was to let them stand on their own legs. At Manchester from 1896 to 1900 they gave £10,000 a year in relief of rates; then it began to take the form of a gradually diminishing sum to the reserve fund. The sum given to the rates was always £10,000; but the reserve fund was a diminishing quantity. In 1900, £4000 was given to the rates; and £484 of this sum was taken from the reserve fund. Fancy the Corporation of the great city of Manchester being reduced to a necessity of this kind.

Alderman SMITH (Liverpool) said the duty of electricity committees was not to the electric light only, but to the municipality. In the broadest sense he gave his services to the Liverpool Municipality and not to the electric light, although he was the inaugurator of the purchase of the undertaking and "had sat on it ever since." In Liverpool during the last eleven years they had contributed £204,911 to the rates. If he had an engineer who fixed his eye upon his station and not upon the results to the ratepayers of the undertaking, he would walk warily with him and depart from him, or see that the engineer departed from him (the speaker) as soon as possible. One gentleman the previous day talked about filching for the rates; and Mr. Pearce talked of plundering the fund. But it was the fund of the Municipality, who had a right to deal with their own in their own way. The Liverpool Electricity Department were not allowed to contribute to the rates until 1914; but they had to go to Parliament to do something with their money, as they were, like Glasgow, becoming plunged in affluence. The ratepayers ought to get it, and should get it by a distinct contribution on their rateable value. The Municipality was entitled to some-

thing for its guarantee. If there were a big disaster like an earthquake, they would have to put it right.

Mr. LEESE (Coventry) said the Corporation in his town had only the electric light and gas works, and no tramways. He agreed with the author that Parliament should limit the rate-aid to 1 or 1¼ per cent., and he was against the electric light department paying anything over to the rates.

Mr. A. G. COOPER (Colne) said, with regard to the use of highways for distributing mains, in his town the Highways Committee did the reinstatement, made it better than it was before, and made the electricity department pay fully for it. He approved of the policy of several towns in taking the money so as to keep down the rates. When a manufacturer was looking for a spot to put down an industry, he asked what were the combined rates—the prices of gas and electricity were secondary considerations.

Mr. CAMPBELL (Brighton) agreed that the duty of a council was to safeguard the interests of the general community, but that would not prevent them from also considering the claims of a particular committee. It was possible to advance the general interests better by reducing the price of current to the lowest possible rate, and supplying it as free and cheap as possible. This might benefit the community more than taking 1d. or 2d. off the rates. He would like to point out to Alderman Bruce that one reason why it was right for Parliament to step in was that the corporation was in the position of a monopolist, and therefore the consumer ought to be protected against its encroachments. If the consumer were allowed to be fleeced by a greedy monopolist, he was in no better case than when he was fleeced by a company.

Bailie WILLOCK (Glasgow) agreed that all their money should go to affording better and cheaper electricity, and not be given for the benefit of ratepayers who were not interested in it. From the Glasgow tramways two years ago they were foolish enough to vote £50,000 to the reduction of occupiers' rates. The result was a man with a family and paying £12 rent got 2s. reduction, and the railway company (the greatest opponent of the tramways) got £1700 reduction. They did not contribute, but the working men contributed £12 or £20 towards the tramway.

Mr. PEARCE, in reply to the discussion, said the people who wanted to take large amounts from the trading profits held up the permissive powers already given them under the Electric Lighting Acts, and those going to the other extreme wanted no contributions. He did not think town councils had the right to take 3, 4, or 5 per cent. on the capital and apply it to reduction of rates, neither could he bring himself to the view that they ought not to give anything. He looked upon parliamentary action as being some safeguard; they had none at present. At Manchester, the Electricity Committee numbered 20 or thereabouts, and they had a Council of 157. What chance had the Committee therefore of forcing its views upon the Council? The Council could take 3, 4, or 5 per cent. on the capital for reduction of rates, and so the charges for current must be framed accordingly. In spite of the fact that some of the recent declarations of Parliament had been arrived at largely by agreement between the parties, they were subject to overriding by Parliament. There had been no attempt to upset these arrangements, and all the indications they could get from legislative acts, and also from views pronounced by Local Government Board Inspectors, tended in the direction of limiting profits for rate-aid. Alderman Bruce had referred to the appointment of the Trading Committee to decide how much should be given of the profits at Manchester. He hoped he would be as enthusiastic about that a little later on. His (Mr. Pearce's) own Committee thought 3 per cent. on capital was a reasonable sum to be contributed to the rates. Alderman Bruce also said that a renewals fund was purely a matter of convenience or policy. It was not; it was a matter of absolute plain duty. In many cases the sinking fund was insufficient to redeem the capital for the plant within its true life; and it was a moral duty to provide against this. It seemed to have been assumed that he was not much in favour of giving the consumers all the advantage; but it had always been his policy to sell as cheaply as possible, and he believed Manchester had the lowest selling price of any undertaking in the country.

FATAL ACCIDENT AT WEYMOUTH.

An inquiry was held last Wednesday at Weymouth regarding the circumstances attending the death of George Palmer, aged 25, who was employed at the gas-works. The accident happened in the retort-house, where Palmer was in charge of a Fiddes-Aldridge stoking machine, which had only been some months installed. The doctor who was called in said he found the man quite dead, and caught by his neck and right arm between the framework of the machinery and the machine itself. Samuel Bolt said on Tuesday morning he was employed with deceased, who was controlling the charging-machine. Palmer ran the machine back from the retorts with coke, and after discharging this was proceeding to pick up coal. Witness suddenly heard a cry of "Murder;" and when he reached the spot, Palmer cried, "Stop the machine." The portion on which deceased leaned was gradually rising; and he could not release himself, having been caught between two bars. He was off his platform. Not understanding the working of the machine, witness ran for help, and it was stopped. The man was then suspended by his neck, dead. Mr. D. F. Colson, the Manager, said the deceased was in sole charge of the machine, and must have started it himself. Palmer knew it from top to bottom. In fact, he was a mechanic, and helped to construct it. He ought not to have left his platform without first having stopped the machine. He should not have got down for the purpose of oiling the machinery. Indeed, witness could not suggest what possessed deceased to make him place his head where it was found, for he had never seen a man put his head there before. Even had he (Mr. Colson) been present, he did not think he could have stopped the machine in time to save deceased. There was nothing the matter with the machinery. Mr. Wolfe, H.M. Chief Inspector of Factories for the Southampton District, said he was quite satisfied, after twenty years' experience, that the machine in question was not dangerous. A wire guard might have been put round where deceased got his head fixed; but witness could honestly say he would not have asked for it before this occurrence.

After the Coroner had summed up, the Jury retired to consider their verdict. After a short absence, they returned into court, when the Foreman said the Jury wished to return a verdict of "Accidental death," and added the following rider: "That the attention of the Home Office be called to this accident, and to the fact that it was stated in evidence that, though the machine has been erected and in use for the past five months, it has not been inspected or seen by any official under the Factory Act. That they ask to see that proper protection, such as a guard or fence, is placed where the accident occurred, to prevent a repetition."

NOTES FROM SCOTLAND.

From Our Own Correspondents.

Saturday.

Banff.—In the House of Commons last Thursday, Mr. M'Kinnon Wood, in reply to a question by Captain Waring, who asked the Secretary for Scotland whether he was aware that the scheme of the Banff District Committee for supplying water to the village of Whitehills involved a rate which the inhabitants of the village would be unable to pay, and that the ratepayers of the district were practically unanimously opposed to the scheme, said the Local Government Board for Scotland had already made full inquiry into the matter, and recommended a loan for the Whitehills water supply scheme from the Public Works Loan Board. Before making this recommendation, they had had under consideration petitions from certain ratepayers objecting to the cost of the proposed scheme; but they were satisfied that the scheme was necessary, and that the cost would not be excessive.

Catrine.—The fifteenth ordinary meeting of the shareholders of the Catrine Gas Company, Limited, was held in the Wilson Hall on Monday night last—Mr. A. D. M. Cook presiding. The statement of accounts for the year ending May 15 was submitted. The gas made during the year was 4,396,000 cubic feet. The coal carbonized was 529 tons, giving an output of 8310 cubic feet per ton. After providing for depreciation of buildings, plant, and machinery, the net balance was £92 12s., which allowed a dividend of 1s. 9d. per share. After paying a bonus to the Manager and the Auditor's fee, a balance of £23 9s. was placed to the sinking fund. The Directors were also empowered to borrow a sum not exceeding £100 per annum for the purpose of gradually taking over the consumers' meters.

Doune.—At a special meeting of the Town Council held on Monday, it was unanimously decided to adopt the Gas Supply (Scotland) Act, in order to purchase the present gas-works. The regular meeting was held in the evening, when the matter of purchasing the gas-works was discussed at length, and it was agreed to make a provisional offer of £1300 for the undertaking.

Dundee.—Meeting as Gas Commissioners on Wednesday, the members of the Town Council fixed the price of gas for the current year at 2s. 2d. per 1000 cubic feet for ordinary consumers, 2s. 6d. for Midmill consumers, and 3s. 2d. for Invergowrie consumers; and at rates ranging from 1s. 6d. to 1s. 11d., according to consumption for industrial purposes.

Dundee.—The accounts of the Dundee Corporation Gas Department for the year to April 30 show that the total quantity of gas delivered was 946,326,000 cubic feet, against 924,313,000 cubic feet in the previous year. The total revenue was 128,057, as compared with £130,610. The price of gas was 2s. 2d. per 1000 cubic feet, as compared with 2s. 3d. per 1000 cubic feet. Of the total income, £89,818 was for gas sold, as compared with £93,483 the previous year. Coke realized £19,684, as compared with £19,908; sulphate of ammonia, £11,486; and tar, £6073—both an increase on the previous year. The expenditure amounted to £97,185; leaving £30,872 to be carried to the net revenue account. Coal cost £49,414. The total expenditure on the manufacture of gas was £70,503. Distribution cost £15,670; rents, rates, and taxes amounted to £6558; and administration to £4453. Of the balance carried to the net revenue account, £6008 has been applied in the payment of annuities, £8351 was required to pay interest, and £11,749 was put to the sinking fund. After paying other charges, there is a net surplus on the year of £2623—a slightly larger amount than was left over last year. The capital debt on the gas-works amounts to £374,612, as against £378,600 a twelvemonth ago. During the year, 81,732 tons of coal were carbonized. Coke produced amounted to 51,098 tons, which was equal to 12·5 cwt. per ton of coal carbonized, exclusive of that required to heat the retorts. There are 48,063 meters in use, 10,077 gas-cookers, 1430 hot-plates, 4236 grillers, 7752 rings—in all, 23,495 gas-cooking appliances. Of fires, radiators, and geysers there are 6455 in use.

Earlston.—The report by the Directors of the Earlston Gas Company for the year ending May 31, states that the business of the Company during the past year has resulted in a profit of £138. The Directors recommended a dividend at the rate of 4s. per share.

Forfar.—At the Town Council meeting on Wednesday evening, on the recommendation of the Gas Committee, it was agreed that first stokers be granted an increase of wages from 4s. 1od. to 5s. per shift, second stokers from 4s. 2d. to 4s. 6d., and the labouring staff 1s. per week extra.

Greenock.—At the monthly meeting of the Greenock Corporation on Tuesday, it was agreed to increase the Gas Manager's salary by £50, making it £450 per annum.

Keith.—The annual meeting of the Gas Company was held on Wednesday—Mr. Adam Annand, Chairman of the Directors, presiding. In view of the increased cost of coal, it was agreed to leave the price of gas as at present—5s. 5d. per 1000 cubic feet. Considerable additions are being made at the works; while a new double main is to be laid along Regent Street, Fife-Keith.

Leith.—A man named William Purves, residing at 139, Great Junction Street, Leith, was, on Thursday night, severely burnt about the head and arms through an explosion of gas in his house. Gas had been escaping in one of the rooms, and a light having been brought in, an explosion occurred.

Leslie.—The report of the Directors of the Gas Company, to be

submitted to the shareholders on July 2, shows a prosperous year's working; the income exceeding the expenditure by £434 9s. 9d. In addition to the usual dividend of 7½ per cent., a bonus of 2½ per cent. is recommended.

Muirkirk.—The annual meeting of the Muirkirk Gaslight Company, Limited, was held on Monday. The report for the year just ended was submitted by the Secretary, Mr. Thomas Jackson, and showed that 4,147,200 cubic feet of gas had been consumed during the year. The profit for the year amounted to £257. The report was unanimously adopted, and a dividend of 10 per cent. was declared.

Strathmiglo.—The water supply of Strathmiglo was the subject of a question in the House of Commons last Thursday, when Lord Ninian Crichton-Stuart asked the Secretary for Scotland whether he would state what steps he proposed to take in connection with the matter. Mr. M'Kinnon Wood replied that the Local Government Board had had under consideration a report by their Medical Inspector on the Strathmiglo water supply. A copy of this report had been communicated to the Local Authority for their consideration on May 20, with a request that they would at once take steps to introduce a proper water supply to the village. A reply had been received from the Local Authority saying that they did not see their way to do so. In view of the position thus created, the matter was receiving further attention.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *June* 22.

Sulphate of Ammonia.

During the past week there has been a paucity of new orders from direct buyers, and the requirements for covering contracts for June shipment have not been large. Consequently, the market has had a drooping tendency all through, and more eagerness has been shown to dispose of parcels for near delivery, the values at the close having receded to £14 10s. per ton f.o.b. Hull, £14 11s. 3d. per ton f.o.b. Liverpool, and £14 10s. per ton f.o.b. Leith. The weaker tone in the near position has had the effect of checking the demand for the distant months, although producers refuse to modify their views as regards the forward price, and no further first-hand business has been reported.

Nitrate of Soda.

The market for this article is quiet but steady at 11s. and 11s. 1½d. per cwt. for ordinary and refined quality respectively, on spot; while in the forward position the tone is very firm.

LONDON, *June* 24.

Tar Products.

The markets for tar products are practically without alteration. Pitch is firm, and the inquiry for forward is regular; but business is difficult to negotiate owing to the high prices. Benzols are strong, and further business is reported in 90 per cent. for delivery over the next twelve months. Solvent naphthas maintain their price, and are still in good demand. Creosote is firm, and a fair amount of business has been done at present quotations. Crude carbolic remains in about the same position.

The average values during the week were: Tar, 28s. to 32s. *ex* works. Pitch, London, 53s. to 54s. 6d.; east coast, 52s. 6d. to 54s.; west coast, Clyde 53s. to 54s. 6d., Manchester 51s. to 53s. 6d., Liverpool 52s. 6d. to 53s. 6d. Benzol, 90 per cent., naked, London, 11d. to 11½d.; North, 11d.; 50-90 per cent., naked, London, 10d.; North, 9½d. Toluol, naked, London, 10½d.; North, 10d. Crude naphtha, in bulk, London, 4¾d. to 5¼d.; North, 4d. to 4¾d. Solvent naphtha, naked, London, 1s. 1d. to 1s. 1½d. f.o.b.; North, 11½d. to 1s. f.o.b. Heavy naphtha, naked, London, 11d. to 1s. f.o.b.; North, 10d. to 10½d. f.o.b. Creosote, in bulk, London, 2⅞d. to 3⅛d.; North, salty, 2½d. to 2⅝d.; liquid, 2⅜d. to 2¾d. Heavy oils, in bulk, 3¼d. to 3⅜d. Carbolic acid, casks included, 60 per cent., east and west coast, 2s. 4d. to 2s. 5d. Naphthalene, £4 10s. to £10; salts, 45s., bags included. Anthracene, "A" quality, 1½d. to 1¾d. per unit, packages included and delivered.

We regret the mistake made in the price of crude naphtha, North, last week. This should, of course, have been 4d. to 4¾d.

Sulphate of Ammonia.

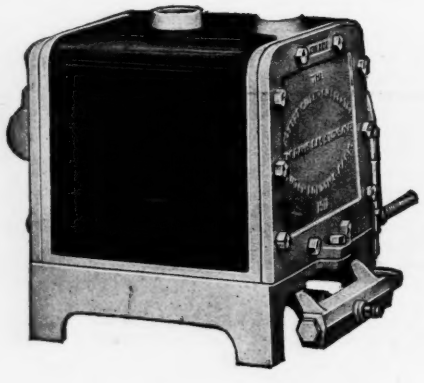
There is little alteration in the price of this article; but on the whole the market is steady, and the inquiry for forward is considerable. Consumers are not willing to pay the prices asked at the moment. Actual Beckton is quoted £14 2s. 6d.; outside London makes, £13 15s.; Hull, £14 10s.; Liverpool, £14 13s. 9d. to £14 15s.; Leith, £14 13s. 9d. to £14 15s.: Middlesbrough, £14 12s. 6d.

COAL TRADE REPORTS.

Northern Coal Trade.

There is a fuller demand for coal, as is usual before the great northern holidays; and with better arrivals of steamers, the shipments are heavier. In the steam coal trade, best Northumbrians are from 12s. 9d. to 13s. per ton f.o.b.; for second-class steams, about 11s. is quoted; and for steam smalls, from 8s. 6d. to 9s. 3d. The production at the collieries is full, and is well taken up. In the gas coal trade, there have been shipments that are above the average for this season. Best Durham gas coals are about 13s. 6d. per ton f.o.b.; second qualities are about 11s. 6d.; and "Wear specials" are 14s. As to contracts, there has been interest felt in those for the Newcastle and Gateshead Gas Company. Heavy quantities were offered, at prices that showed a very sharp advance—from 12s. being given as the price asked—but the result is not yet officially declared, though counter offers are expected. Some sales of Durham gas coals are believed to have been

Gas-Heated Water.



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made for the Brussels Gas-Works at prices near those given above as current quotations; and a few cargoes have also been sold for Italian ports. The gas coal demand is good for this season. Coke is rather higher in price. Gas coke is about 18s. to 18s. 3d. per ton f.o.b.

Scotch Coal Trade.

The feature of the Scottish coal trade this week has been the activity in the various departments, and the steadiness of the prices ruling. The export market is firmer at a slight increase in prices. On Friday, the f.o.b. prices in Glasgow were approximately: Steam coal, 11s. to 11s. 6d.; splint, 11s. 3d. to 11s. 9d.; ell, 10s. 9d. to 11s. 3d.; trebles, 10s. 9d. to 11s.; doubles, 10s. 6d. to 10s. 9d.; and singles, 10s. 9d. to 11s. 3d. Throughout the Lothians and Fifeshire, the prices show an upward tendency, and outputs are readily disposed of.

GAS COAL PRICES.

The following remarks on this subject appeared in the "Iron and Coal Trades Review" last Friday.

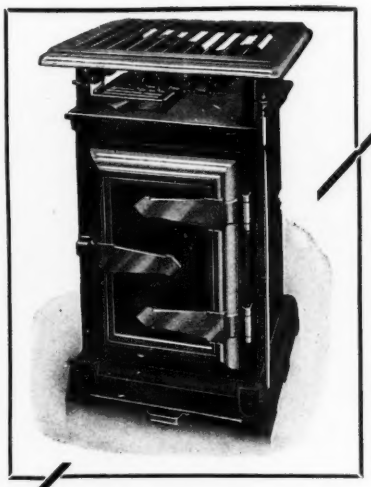
In past years, the policy of collieries in regard to gas coal contracts has been severely criticized, since large quantities have been sold to works direct at prices below those quoted to merchants; the only difference in the coal itself being in the size of screens over which it is passed. In fact, gas coals have been sold at prices which have resulted in a direct loss to the producers. It is generally understood that this season collieries will insist on an advance of 2s. 6d. per ton upon last year's prices for contract renewals. There are a large number of inquiries in the market, while a moderate tonnage has already been placed at the advance mentioned; and if collieries will only hold together for these terms, there will be no alternative for gas concerns but to accept them, as they cannot afford to risk obtaining more than a small proportion of their requirements on the open market, especially in view of the wave of unrest that is now passing over the labour world.

Naturally, gas undertakings are "up in arms" against the advance of 2s. 6d. per ton; but apart from the question of any increase in the price of gas to consumers, they are now able to obtain a much greater revenue from their residuals. Last year, at some of the large works, the revenue from the sales of residuals was almost equal to the cost of the coals consumed; and the present value of sulphate of ammonia is about £14 per ton on rail, while tar and coke are also higher in price. What has always been the weak spot in regard to the gas coal trade is the lack of a solid agreement among collieries; and unless there is a heavy monetary penalty, there is always the risk of some underselling by pits seeking to extend their connection, although it is satisfactory to note that this year there appears to be a fixed determination to obtain prices for gas fuels which will leave a fair margin of profit. From a colliery owner's point of view, there is undoubtedly a deal to be said in regard to the question of forming a pooling arrangement for selling gas coals, with a central sales office for each producing district, which would save the expenses of canvassing gas-works. The basis of the first year's tonnage might be arrived at by ascertaining the average sales of gas coals over a period of years; while qualities could be graded into classes, and all prices fixed by a central board.

Profit Sharing and Price at Merthyr.

The following is taken from the "Merthyr Express:" A little over a year ago, the Merthyr Gas Company started a co-partnership scheme upon the lines of the well-known and extremely successful scheme which has been in operation at South London Gas-Works, where it was introduced by Sir George Livesey, the Chairman at the time. I am glad to say that the hopes expressed in the "Express" in commenting upon the new departure of the Company have been realized. The first year's results have been to give the employees of the Company an increase of 3 per cent. in wages and salaries, and concurrently an increase of one-eighth per cent. in the dividend upon the stock of the Company. The benefits accruing from the operations of the Company under the scheme do not end here, for under the terms of the Company's Act of 1906, the shareholders cannot receive an increment of dividend without making a corresponding reduction in the price of gas. So the addition of one-eighth per cent. to the dividend carries with it 1d. per 1000 cubic feet reduction in the price of gas. The Company have accordingly given notice that on June 30 the price will be reduced from the standard 2s. 9d. to 2s. 8d. per 1000 cubic feet. Those who use slot-meters will share in this reduction, and also, it is to be presumed, those who consume gas for motive power. A penny per 1000 cubic feet does not seem to be much; but it will amount to a large sum upon a consumption of millions of cubic feet. Consumers will be grateful for the abatement, which comes as a pleasant surprise in face of the fact that coal has become dearer, and is not likely ever again to be purchasable at the prices ruling a short time ago. Mr. J. E. Kenshole, the General Manager, is to be heartily congratulated upon his very successful management, which has brought benefit to all parties interested in the welfare of the Company.

Padiham Gas-Works Profit.—The annual report of Mr. A. J. Harrison, Engineer and Manager of the Padiham Gas-Works, was submitted at last Thursday's meeting of the Council. It showed that the gas made during the twelve months amounted to 81,914,000 cubic feet, an increase of 3,520,000 cubic feet on the previous year, and that the quantity unaccounted for was 3,108,000 cubic feet, equal to 3·78 per cent. The income totalled £16,548, and the expenditure £10,213—leaving a gross profit of £6335. After the payment of interest on annuities and loan and sinking fund charges, there was left a net profit of £1350—an increase of £206.



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Gas Triumphs over Electricity at Doncaster.

Gas has triumphed over electricity in reference to the interesting street lighting experiment recently conducted at Doncaster by the Corporation. At a meeting of the Lighting Committee this week to consider the result of the experiments, the Gas Engineer (Mr. Robert Watson) and the Electrical Engineer (Mr. E. S. Rayner) attended. After going very fully into the matter and inspecting diagrams which had been prepared by both engineers with regard to light curves and matters of this sort, it was decided to recommend to the Council that the main thoroughfares of Doncaster be lighted by gas and not by electricity, in a manner similar to that adopted in High Street during the last few weeks. The Committee's decision is, of course, subject to the approval of the Council, before whom it will shortly be brought.

Control of Municipal Finance at Manchester.

Considerable discussion took place at the Manchester City Council meeting last Wednesday with regard to the report of the Finance Committee for securing continuous supervision and control of the expenditure in the various departments of the Corporation. As stated in the "JOURNAL" for June 4 (p. 666), the report does not in its main recommendations affect the trading Committees; but the Finance Committee hold that all new proposals for expenditure should be brought more prominently before the Council, and estimates of all such proposals presented to the Council by the Finance Committee. The adoption of the report was opposed by a number of speakers at last Wednesday's meeting of the Council. It was argued by Mr. Jackson that if the report was adopted, no real economical policy would result. In his opinion, the best way was to insist upon increased exchequer contributions. Alderman Jones observed that it would not be very edifying for Committees to have to go "cap in hand" to the Finance Committee for leave to spend money upon needed improvements—necessary work being held up in the meantime. Alderman Holt asked the Council to look upon the report as aiming at better management of municipal finance, and added that personally he would like to see a general manager over the whole of the corporation concerns. Why, he asked, should the revenue expenditure not be controlled in the same way as the capital expenditure? It was his opinion that the real stumbling block in the way of retrenchment was the enormous sums paid in interest and sinking fund charges, and the scheme of the Finance Committee was intended to guard against waste. Finally, the Council decided, by a substantial majority, to refer the report back for further consideration.

Selby Gas-Works Profit.—The annual report of the gas-works which has been presented to the Selby Urban District Council shows that the gross profit for the past year amounts to £3430. After deducting interest on loans, &c., there is a net profit of £924, which is an increase of £58 on the previous year.

Coventry's Water Supply.

The rapid expansion of Coventry has necessitated steps being taken to increase the local water supply. A Sub-Committee have been in negotiation with the Birmingham Corporation, with a view to securing an extension of the supply received from them. They have accordingly recommended that an arrangement be entered into on the following lines: The present maximum quantity of 2 million gallons per day which Coventry can require from Birmingham to be increased to 3 million gallons per day for the period to March 31, 1967. The maximum supply for the current year, ending March 31, 1913 (and for subsequent years until further demand is made by Coventry), to be increased from 2 to 2¼ million gallons per day. In consideration thereof, Coventry is to agree to an increase in the minimum supply from 822,000 gallons per day, as at present, to 1,125,000 gallons per day, and to a consequent increase in the minimum annual payment from £5000 to £6844. The necessary alteration to the Venturi meter at Shustoke, to increase its capacity to 3 million gallons, is to be made immediately upon the agreement being completed, at a cost not to exceed £100—such cost to be borne by Coventry. The cost of any alterations to the engines necessitated by the increased supply is to be also borne by Coventry. It is pointed out that no alteration in the machinery will be necessary until the maximum daily quantity required amounts to 2½ million gallons, and then it is not to exceed £500.

Middleton Gas-Works Record Year.

The annual working statement of the Middleton Corporation gas undertaking, which has been issued to members of the Council, shows that the gas sold in the twelve months ended March 31 last amounted to 130,937,300 cubic feet—an increase of 5,602,500 cubic feet, or 4·28 per cent., compared with 5·93 per cent. in the preceding year, or 10,620 cubic feet per ton of coal carbonized, The unaccounted-for gas in the past year amounted to 9,521,700 cubic feet, or 6·67 per cent.; the average taken over the last five years being 6·87 per cent. The quantity of gas made in the twelve months under notice was 142,622,000 cubic feet, an increase of 6,622,000 cubic feet. The coal carbonized totalled 12,329 tons, an increase of 505 tons. The make of gas per ton was 11,556 cubic feet, which was again a record, and regarded as very satisfactory in view of the stoppage in deliveries of coal for six weeks during the strike. There was expended on coal and cannel £8014, compared with £7503 in the previous year—having cost 13s. per ton, or 4d. more than in the preceding year. Coke produced an increased revenue of £837; the amount available for sale being 8280 tons, or 13·43 cwt. per ton of coal carbonized. Tar sold at an average of 25s. 2d. per ton, against 21s. 6d. the year before. Notwithstanding the adverse circumstances connected with the coal stoppage, the consequent temporary reduction in consumption, and high prices paid for coal during this period, together with a reduction in the price of gas, the past year exceeded all previous years in prosperity. As already stated in the "JOURNAL," the net profit on the year was £3149.

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A Satisfactory Report at Droitwich.

In his fifth annual report on the working of the Droitwich Corporation Gas Department, Mr. F. Shewring, the Manager, states that the gas sold during the past year was 9·4 per cent. more than in the preceding twelve months; this being the largest annual increase since 1900. The sales have increased over 26 per cent. since 1908. The yield of gas per ton of coal carbonized was 11,001 cubic feet, against 10,901 feet the previous year; while the gas accounted for was 10,331 cubic feet per ton of coal, or 138 feet more than last year's record figure. The unaccounted-for gas has been reduced from 6·48 to 6 07 per cent. After allowing for depreciation, there is a gross profit of £1295. Deducting repayment of principal £315, interest on loans £115, and additions to plant £900, there is a debit balance of £35. In June last, the Committee again reduced the price of gas 2d. per 1000 cubic feet (making it 2s. 10d. net); and there were also concessions in the charge for public lighting and meter-rents. The gas-rental shows an increase of £125, notwithstanding the lower price. The report was generally regarded as being highly satisfactory.

Sale of Stocks and Shares.

The sale of gas and water stocks and shares conducted by Messrs. A. & W. Richards at the Mart, Tokenhouse Yard, E.C., last Tuesday included two new issues of gas capital and two new issues of water capital. In the South-West Suburban Water Company, 1000 £10 5 per cent. preference shares were sold at £12 10s. each; £5000 of 4 per cent. irredeemable debenture stock, at par; and 120 £10 fully-paid original shares (ranking for a maximum dividend of 10 per cent., but receiving 7 per cent. per annum), at £17 5s. each. An issue of £5000 of 5 per cent. preference stock in the Southgate and District Gas Company was disposed of at the rate of £112 per £100; and £2500 of additional ordinary stock (ranking for a maximum dividend of 7 per cent. which is paid on similar existing stock), at the rate of £139 to £140 per £100. In the Grays and Tilbury Gas Company, 300 £10 "B" shares (ranking for a standard dividend of 7 per cent. equally with existing "B" shares, on which £5 19s. per cent. per annum is paid) sold at £11 2s. 6d. and £11 5s. each; while the price realized for £500 of 4 per cent. perpetual debenture stock was £98 5s. per £100. An issue of £1000 of 4 per cent. perpetual debenture stock in the Great Yarmouth Water-Works Company realized from par to £100 5s. per £100; and £4000 of new ordinary stock (ranking for a maximum dividend of 7 per cent., equally with existing similar capital, which is receiving 4 per cent. per annum) was disposed of at £90 10s. to £91 5s. per £100. In the Christchurch Gas Company, 56 £10 fully-paid original shares (maximum dividend 10 per cent., receiving 5 per cent. per annum) were sold at £9 10s. each; and 11 £10 fully-paid additional shares (maximum dividend 7 per cent, receiving 3½ per cent. per annum), at £6 15s. each.

Oldham Corporation Gas Profits.

The net profit on the working of the Oldham Corporation gas undertaking for the past financial year was £17,638. A sum of £7500 is transferred to the borough fund account (as last year), £6300 to the reserve fund, and £1650 to capital account for depreciation in gas-cookers. During the year, there was spent on gasholders £8488, which comes under the head of "extraordinary expenditure," and the credit balance in the profit and loss account is reduced from £24,139 to £19,488. The credit balance in the reserve fund is increased from £41,820 to £47,978. At last Wednesday's meeting of the Gas Committee, when the statement was presented, Mr. Arthur Andrew (the General Manager) said it was better than that of the preceding year. For the year ended March 31, 1911, the balance carried to profit and loss account was £47,425. The annuities absorbed £3348, interest on loans and stock £13,949, and sinking fund charges, &c., £6655, leaving a balance of £23,473. Adding the balance brought forward (£19,158), and deducting the sums transferred to the borough and reserve funds (£7500 and £6000), the cost of renewing the Higginshaw gasholder (£3342), and the amount written off for depreciation on cooking-stoves (£1650), there was £24,139 to be carried forward.

Neath Gas-Works Results.—The Neath Corporation gas undertaking made a profit of £6700 on the last year's working. This result is looked upon as eminently satisfactory, having regard to the difficulties created by the railway and coal strikes.

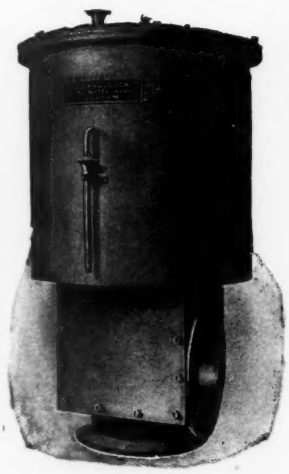
Hull Water and Gas Profits.—At a meeting last week of the Hull Corporation Water and Gas Committee, the City Accountant submitted the statement of accounts of the water and gas undertakings for the past year. The water undertaking showed an income of £67,588, and an expenditure of £29,540, leaving a gross profit of £38,048. The £15,000 contributed for the relief of the rates compares with £12,000 last year. The gas undertaking showed an income of £11,814, and expenditure of £8927, leaving a gross profit of £2887.

Maryport and Coke-Oven Gas.—A Special Committee appointed by the Maryport Urban District Council to report on the use of coke-oven gas for lighting purposes, recommended that the Council should proceed no further at present with the negotiations with the Flimby and Broughton Moor Colliery and Fire-Brick Company for the purchase and use of coke-oven gas. In explanation of this decision, Mr. Hardy said that in the making of gas from coke-ovens a great deal depended upon the climatic conditions. In time of storm the illuminating power was practically *nil*, and the supply was also liable to break down. The Committee had further taken into consideration the fact that there was not a great amount of experience of coke-oven gas supplies for illuminating purposes. The minutes were confirmed, after one or two members had expressed the opinion that, in spite of the Committee's present decision, they believed coke-oven gas was the illuminating medium of the future.

BRADDOCK'S

RETORT-HOUSE

GOVERNORS.

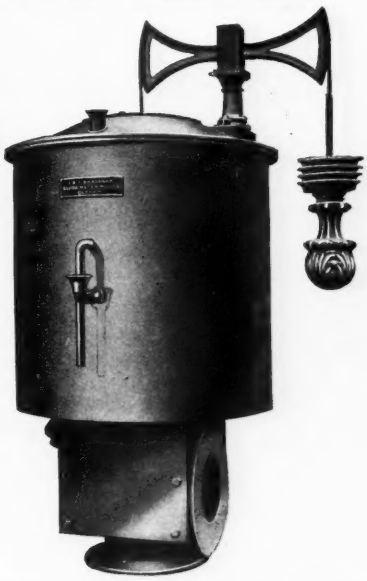


No. 193.
Braddock's Enclosed Retort-House Governor, with Internal Float.

SECOND TO NONE.

For Efficiency and Reliability.

Many Repeat Orders have been received.



No. 244. Braddock's Enclosed Retort-House Governor, Beam Type.

J. & J. BRADDOCK (BRANCH OF METERS LIMITED), Globe Meter Works, OLDHAM,

Telegrams: "BRADDOCK, OLDHAM." National Telephone No. 815.

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Telegrams: "METRIQUE, LONDON." Telephone No. 2412 HOP.

Gas-Furnaces in Dundee.—The Dundee Gas Department have once more given their consumers evidence of the progressive policy with which Mr. Alex. Yuill, the Engineer and Manager, has always identified himself. The department were in the vanguard when slot installations and the simple hire of cookers brought an increased load to gas manufacture. Following the same policy, they have quite recently installed a permanent gas-furnace test installation, which has been provided for the use of the department's industrial consumers. The gas-furnaces are fitted at the works, and may be seen in operation by any interested party for test purposes. Many of the leading Dundee manufacturing firms have already availed themselves of this useful opportunity, particularly in connection with brass melting and case-hardening. With the special discounts allowed for gas used for industrial purposes, there is no doubt that many of the Dundee firms will avail themselves of the advantages of the use of gas as a commercial fuel for their purposes.

Electric Lighting in the City.—At a meeting of the Court of Common Council last week, a report was presented by the Streets Committee relative to the powers of the Corporation to purchase so much of the undertakings of the City of London Electric Lighting Company and the Charing Cross, West End, and City Electricity Supply Company as relate to the City. The Committee stated that it would be inexpedient to take any steps in the matter at the present time, and recommended that such rights of purchase be not exercised in 1914 or 1915. Mr. Deputy Millar Wilkinson asked what period must elapse before the Corporation could again exercise a right to purchase, and said there had been a fearful amount of gambling in these shares on the strength of a rumour that the Corporation were going to buy the undertakings. The price had jumped from £14 to £22 10s. Mr. Stanham replied that the Corporation had the right to purchase in 1914 or 1924. Mr. Deputy Morton, M.P., added that the Committee were quite against the purchase. The report was adopted.

Blackburn Gas Accounts.—From the abstract of the Treasurer's accounts of the Blackburn Gas Department for the year to March 25, it appears that the net receipts from the sales of gas were £96,479 (the quantity sold being 684,991,175 cubic feet). Residuals realized £24,034, and the total income was £124,358. The expenditure came to £77,721, leaving a balance of £46,637 to be carried to the net revenue account. After meeting charges for interest and redemption of debt, there remained a sum of £13,324, which was carried to the reserve fund account. The working statement appended shows that 59,038,825 cubic feet, or 7·9 per cent. of the make, was unaccounted for; the total make having been 744,030,000 cubic feet. The quantity of coal carbonized was 53,205 tons, and of oil (equivalent in coal) 11,325 tons. The gas made per ton of coal was 11,530 cubic feet, and the sale 10,488 feet per ton. The net cost of coal was 5·41d. per 1000 cubic feet sold, and 4s. 8·77d. per ton of coal carbonized; and the net profit amounted to 4·73d. per 1000 feet, and 4s. 1·55d. per ton. The total length of mains is 128 miles and 1024 yards.

Price of Gas at Rochdale.—The Rochdale Corporation Gas Committee, at last Wednesday's meeting, had before them a letter from the local Trades Council suggesting that, in view of the large profits made on the working of the undertaking last year, and prospectively, there should be a reduction in the price of gas supplied for domestic purposes. The Secretary of the Trades Council asked that the Gas Committee should receive a deputation from the Council to discuss the matter. It was agreed to meet such a deputation in a fortnight's time. From the end of September, 1911, the price of gas for lighting purposes was reduced by the Gas Committee by 2d. per 1000 cubic feet to consumers through ordinary meters, and by 3d. to prepayment meter customers. The charge to ordinary consumers to-day is 2s. 6d. per 1000 cubic feet.

Gas-Works Extension in Paris.—In connection with the meeting of the Soeiété Technique in Paris last week, the proceedings at which are recorded elsewhere, it may not be uninteresting to quote the following remarks of the "Engineer" on the extensions in contemplation at the gas-works of the city to improve the supply, for which a loan of 205,000,000 frs. was recently largely over-subscribed—showing the public confidence in the gas undertaking: "The new loan is intended principally to provide further facilities for distributing gas, of which the consumption has been growing enormously during the past few years. It increased from 395,000,000 cubic metres in 1905 to 422,000,000 cubic metres in 1910, while from 1907 to 1911 the number of consumers augmented from 550,000 to 675,000. It is true that this coincides with a reduction in the price of gas from 30 c. to 20 c. per cubic metre. With the funds now raised, it is proposed to erect new gas-works and increase the capacity of the existing ones; while the most up-to-date machinery and mechanical appliances will be employed for manipulating the coal and coke. The production of gas will, it is believed, be increased 50 per cent., while the charges will be reduced in a large proportion. This represents only a small part of the work to be undertaken during the next few years."

Stokers working twelve-hour shifts at the Bingley Gas-Works are to be paid at the rate of 5s. 6d. per shift. This alteration will entail an increased cost of £70 a year.

A successful exhibition of cookers, fires, and general gas appliances has just been held under the auspices of the Gas Company at Wickham Market, by the Richmond Gas Stove and Meter Company. Cookery lectures were given by Miss Surridge. Great interest was evinced by large audiences daily, and a number of orders were placed.

Under the auspices of the Dundee Gas Department, a lecture on the value and utility of gas as a fuel for the firing of furnaces was recently given by Mr. E. P. Taudevin, of the Richmond Gas Stove and Meter Company. The members of the audience were considerably influenced by the details of the advantages expounded in favour of gas, and no doubt good results will accrue to the Gas Department.

THE LATEST IN SLOT COOKERS.

Look at the illustration and size it up, note its massive appearance, then place an actual cooker in your showroom and see its well finished appearance (far ahead of the average slot cooker), latest fittings, large oven, &c.

All Parts are Interchangeable.

NO DELAYS IN GETTING RENEWALS.
One in your Showroom is bound to bring good results, because it is a

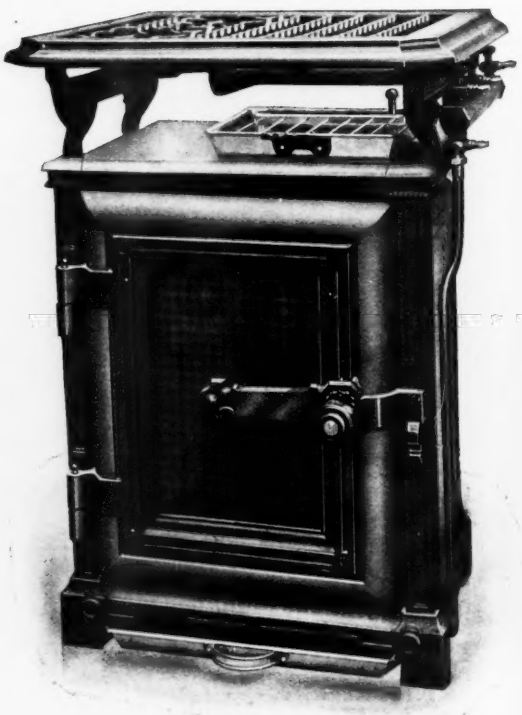
PARKINSON

a name which stands for all that is best in cooker construction.

PRICES AND FULL PARTICULARS ON APPLICATION.

THE PARKINSON STOVE CO., LTD.,
BIRMINGHAM & LONDON.

THE SLOT COOKER FOR 1912.



WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments, &c., Vacant.

SECRETARY. South Suburban Gas Company. Applications by July 8.
ASSISTANT-MANAGER (Australia). No 5596.
TECHNICAL ASSISTANT. Wallasey Gas and Water Department. Tenders by July 8.
DRAUGHTSMAN. Ashmore, Benson, Pease, and Co., Stockton-on-Tees.
DRAUGHTSMAN. No. 5594.
ASSISTANT (Knowledge of Photometry, &c.). No. 5598.
JUNIOR DRAUGHTSMAN. Edward Cockey and Sons, Limited, Frome.
TRAVELLER. No. 5583.
RETORT SETTER. Devonport Gas Department. Applications by June 29.
STOKERS. Redditch Gas Company.

Appointments, &c., Wanted.

WATER-GAS ENGINEER. No. 5597.
SULPHATE PLANT MAKER AND REPAIRER. No. 5592.

Plant, &c. (Second-Hand), for Sale.

LAMP COLUMNS AND LANTERNS. Barnsley Gas Company.
PREPAYMENT METERS, STEAM BOILER, FORGE AND ANVIL, CONDENSERS, &c. Centenary Gas Company, Glasgow.
RETORT BENCH IRONWORK, PIPES, &c. Lurgan Gaslight Company.

Stocks and Shares for Sale.

ANNFIELD PLAIN AND DISTRICT GAS COMPANY. London Mart. July 2.
ASCOT GAS AND ELECTRICITY COMPANY. London Mart. July 2.
EAST GRINSTEAD GAS AND WATER COMPANY. London Mart. July 2.
NORTH MIDDLESEX GAS COMPANY. London Mart. July 2.

TENDERS FOR

Benzol.

WARRINGTON GAS DEPARTMENT. Tenders by July 8.

Coal and Cannel.

ABERAVON GAS DEPARTMENT. Tenders by July 1.
ABERTILLERY GAS DEPARTMENT. Tenders by July 3.
BRIDGNORTH GAS DEPARTMENT. Tenders by June 29.
BRIERLEY HILL GAS COMPANY. Tenders by July 6.
DEWSBURY GAS DEPARTMENT. Tenders by July 6.
DROITWICH GAS DEPARTMENT. Tenders by July 8.
GLOSSOP GAS COMPANY. Tenders by July 13.
ILKESTON GAS DEPARTMENT. Tenders by July 28.
LIMERICK GAS DEPARTMENT. Tenders by July 1.
LINCOLN GAS DEPARTMENT. Tenders by July 13.
LURGAN GASLIGHT COMPANY. Tenders by July 1.
MIDDLETON CORPORATION. Tenders by July 4.
RAMSEY GASLIGHT AND COKE COMPANY (HUNTINGDONSHIRE). Tenders by July 1.
RHONDDA GAS AND WATER DEPARTMENT. Tenders by July 4
SELBY GAS COMPANY. Tenders by July 4.
SEVENOAKS GAS COMPANY. Tenders by July 2.
STOKE-ON-TRENT GAS UNDERTAKINGS.
WARRINGTON GAS DEPARTMENT. Tenders by July 8.

Cookers and Fires.

WARRINGTON GAS DEPARTMENT. Tenders by July 8.

Fire-Clay Goods.

WARRINGTON GAS DEPARTMENT. Tenders by July 8.

General Stores (Ironmongery, Castings, Bricks, Flexible Tube, Glass, Iron and Steel, Lead Pipe, Oils and Paints, Drysalteries and Vitriol, Lime, Cement, &c.).

WARRINGTON GAS DEPARTMENT. Tenders by July 8.

Lamps and Fittings, Taps and Valves.

WARRINGTON GAS DEPARTMENT. Tenders by July 8.

Meters.

WARRINGTON GAS DEPARTMENT. Tenders by July 8.

Pipes, &c.

RHONDDA GAS AND WATER DEPARTMENT. Tenders by July 4.
WARRINGTON GAS DEPARTMENT. Tenders by July 8.

Purifier Grids.

WARRINGTON GAS DEPARTMENT. Tenders by July 8.

Tank Waggon.

WARRINGTON GAS DEPARTMENT. Tenders by July 8.

Roof (Steel).

SHEFFIELD GASLIGHT COMPANY. Tenders by July 3.

Tar.

BRIERLEY HILL GASLIGHT COMPANY. Tenders by July 6.
PENRITH GAS DEPARTMENT. Tenders by July 1.

GAS COMPANIES' STOCK AND SHARE LIST.

Business was very quiet on the Stock Exchange last week; the glorious weather and sportive attractions having something to do with it But, apart from this, the public are in the mood to "lie low" and wait for another turn of the kaleidoscope. Things have not pleased them lately. Strikes and rumours of strikes, a record fall in Consols, grave anxieties arising from wild speculations (another failure was announced last week), Home and Foreign politics, and now a bogey of synthetic rubber threatening one of their favourite adventures, all these are not calculated to infuse cheerfulness. So last week was but dull at the best. The opening day was heavy. Government issues, after a fair start, received a check. Railways were troubled by too much stock on offer; and Americans were irregular, mostly for the worse. Tuesday's business was very quiet—Ascot being more tempting than Capel Court. Markets were quite flat. Gilt-edged descriptions were very weak; and Consols fell $\frac{1}{4}$ money and $\frac{3}{8}$ account. Railway prices were lower. Wednesday was much the same, only worse. Consols established a new low record—touching $75\frac{37}{32}$. This was understood to be caused by sales to meet financial requirements, and not inspired by mistrust of the Government policy. Everything else was dull and heavy. Thursday was relieved by the announcement that the Government would make a liberal appropriation out of the surplus to the Sinking Fund, and Consols jumped up $\frac{3}{8}$; but other markets could not be cheered. On Friday, the gilt-edged division were irregular, but Consols did not move. Rails were flat on dissatisfaction with dividend prospects; but Americans had a recovery. Saturday was as quiet as could be. Consols closed at $76\frac{1}{4}$ to $76\frac{1}{2}$—the same as the Saturday before—with a firm appearance. Rails were still rather depressed; and Americans were not so strong. In the Money Market, the position was very steady and firm. Business in the Gas Market still continued quiet and below the average, but was a little brisker than the week before. There were not many changes in quotation, and they were inconsiderable and irregular, and some of them not quite transparently intelligible. In Gaslight and Coke issues, the ordinary was moderately in evidence. The figures at which transactions were recorded showed practically no change—$103\frac{1}{2}$ to $104\frac{1}{2}$—but the quotation was lowered $\frac{1}{4}$. In the secured issues, there was little done; the maximum marking 85 and $85\frac{1}{2}$, the preference 102 and $102\frac{1}{4}$, and the debentures $76\frac{3}{4}$ and $77\frac{1}{2}$. But the quotations were shaken up; the maximum showing $+\frac{1}{2}$, the preference $-\frac{1}{2}$, and the debenture $+\frac{1}{4}$. South Metropolitan was quiet and without change, prices ranging from 118 to $119\frac{3}{4}$. Nothing was done in Commercials. Among the Suburban and Provincial group, Bournemouth "B" realized $16\frac{1}{4}$ (a rise of $\frac{1}{4}$), Brentford old 260 and 262, Brighton original 216, Bromley "A" $132\frac{1}{2}$, Ilford "A" and "C" 156, ditto "B" $123\frac{1}{2}$, Southampton 106. In Continental companies, Imperial made from 183 to $185\frac{1}{2}$, ditto debenture $89\frac{3}{4}$, Union 84 and $85\frac{1}{4}$ (a rise of 1), European $10\frac{1}{8}$, Malta $4\frac{3}{4}$, and Tuscan $8\frac{1}{8}$. Among the undertakings of the remoter world, Bombay marked from $6\frac{1}{8}$ to $6\frac{1}{4}$, Monte Video $11\frac{1}{2}$, Ottoman $7\frac{1}{2}$, Oriental $135\frac{1}{2}$, Primitiva $7\frac{3}{16}$ and $7\frac{1}{4}$, ditto preference from $5\frac{1}{8}$ to $5\frac{7}{16}$, and ditto debenture $96\frac{1}{2}$.

Issue.	Share.	When ex-Dividend.	Dividend or Interest & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	Apl. 12	5	Alliance & Dublin Ord.	73—78	..	6 8 2
374,000	Stk.	Jan. 12	4	Do. 4 p.c. Deb.	91—93	..	4 6 0
250,000	5	Apl. 12	7½	Bombay, Ltd.	6—6½	..	5 15 5
50,000	10	Feb. 29	15	Bourne- mouth Gas & Water	10 p.c.	..	5 1 8
332,000	10	"	7		B 7 p.c.	+½	4 3 7
75,000	10	"	6		Pref. 6 p.c.	..	4 1 4
380,000	Stk.	"	13	Brentford Consolidated	258—263	..	4 18 10
330,000	"	"	10	Do. New	196—201	..	4 19 6
50,000	"	"	5	Do. 5 p.c. Pref.	118—120	..	4 3 4
206,250	"	June 14	4	Do. 4 p.c. Deb.	95—97*	..	4 2 6
219,055	Stk.	Feb. 29	11	Brighton & Hove Orig.	215—220	..	5 0 0
244,200	"	"	8	Do. A Ord. Stk.	156—159	..	5 0 8
490,000	20	Mar. 28	12½	British	44½—45½	..	5 9 11
120,000	Stk.	Dec. 29	4	Do. 4 p.c. Deb. Stk.	93—95	..	4 4 3
109,000	"	Feb. 15	6	Bromley, A 5 p.c.	128—133	..	4 10 3
165,700	"	"	4½	Do. B 3½ p.c.	98—101	..	4 9 1
82,278	"	"	5½	Do. C 5 p.c.	117—120	..	4 11 8
55,000	"	Dec. 29	3½	Do. 3½ p.c. Deb.	80—82	..	4 5 4
250,000	Stk.	"	4	Buenos Ayres 4 p.c. Deb.	95—97	..	4 2 6
100,000	10	—	—	Cape Town & Dis., Ltd.	2—3	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	4—5	..	—
100,000	Stk.	Dec. 29	4½	Do. 4½ p.c. Deb. Stk.	76—80	..	5 12 6
157,150	Stk.	Feb. 15	5	Chester 5 p.c. Ord.	110—112	..	4 9 3
1,513,280	Stk.	Feb. 29	5/9/4	Commercial 4 p.c. Stk.	108—110	..	4 19 4
560,000	"	"	5½	Do. 3½ p.c. do.	103—105	..	5 1 6
475,000	"	June 14	3	Do. 3 p.c. Deb. Stk.	73—75*	..	4 0 0
800,000	Stk.	May 31	4	Continental Union, Ltd.	83—86	+1	4 13 0
200,000	"	"	7	Do. 7 p.c. Pref.	133—135	..	5 3 8
492,270	Stk.	—	5½	Derby Con. Stk.	122—124	..	4 8 9
55,000	"	—	4	Do. Deb. Stk.	104—105	..	3 16 2
840,150	10	Jan. 31	10	European, Ltd.	19½—20½	..	4 17 7
16,160,600	Stk.	Feb. 15	4/14/8	Gas- light and Coke	4 p.c. Ord.	103½—104½	–½	4 10 7
2,600,000	"	"	3½		3½ p.c. max.	85—87	+½	4 0 6
4,062,235	"	"	4		4 p.c. Con. Pref.	101½—103½	–½	3 17 4
4,531,705	"	June 14	3		3 p.c. Con. Deb.	76½—78½*	+¼	3 16 5
258,740	Stk.	Mar. 14	5	Hastings & St. L. 3½ p.c.		93—95	..	5 5 3
82,500	"	"	6½	Do. do. 5 p.c.		—	..	—
70,000	10	Apl. 26	11	Hongkong & China, Ltd.		16½—17	..	6 9 5
131,000	Stk.	Mar. 14	7½	Ilford A and C		155—158	..	4 14 11
65,780	"	"	6	Do. B		123—125	..	4 16 0
65,500	"	Dec. 29	4	Do. 4 p.c. Deb.		93—95	..	4 4 3
4,940,060	Stk.	May 15	9	Imperial Continental		183—187	..	4 16 3
1,235,000	Stk.	Feb. 15	3½	Do. 3½ p.c. Deb. Red.		88—90	..	3 17 9
200,242	Stk.	Mar. 14	6	Lea Bridge Ord. 5 p.c.		125—129	..	4 13 0
561,000	Stk.	Feb. 29	10	Liverpool United A.		219½—221½	..	4 10 3
718,100	"	"	7	Do. B.		158—160	..	4 7 6
306,083	"	Dec. 29	4	Do. Deb. Stk.		100—102	..	3 18 5
75,000	5	June 14	6	Malta & Mediterranean		4⅝—4¾*	..	6 3 1
560,000	100	Apl. 1	5	Met. of	5 p.c. Deb.	100—102	..	4 18 0
250,000	100	"	4½	Melbourne	4½ p.c. Deb.	101—103	..	4 7 5
541,920	20	May 31	3½	Monte Video, Ltd.		11½—12	..	5 16 8
1,775,892	Stk.	Feb. 15	4½	Newc'tle&G'tesh'd Con.		100—102	+1	4 5 9
529,705	Stk.	Dec. 29	3½	Do. 3½ p.c. Deb.		86—88	..	3 19 7
55,940	10	Feb. 29	7/7/0	North Middlesex 7 p.c.		14—15	..	4 18 0
300,000	Stk.	May 15	8	Oriental, Ltd.		134—136	..	5 17 8
60,000	5	Mar. 14	8	Ottoman, Ltd.		7—7½	..	5 6 8
31,800	53	Feb. 29	13	Portsea Island A		137—140	..	4 18 4
60,000	50	"	13	Do. B		130—133	..	4 17 9
100,000	50	"	12	Do. C		127—130	..	4 12 4
398,490	5	May 15	8	Primitiva Ord.		7—7¼	..	5 10 4
796,980	5	Dec. 29	5	Do. 5 p.c. Pref.		5 1/16—5 5/16	–1/16	4 14 1
488,900	100	June 1	4	Do. 4 p.c. Deb.		96—98	..	4 1 8
312,650	Stk.	Dec. 29	4	River Plate 4 p.c. Deb.		95—97	..	4 2 6
275,000	5	Apl. 12	12	San Paulo, Ltd.		11¼—11¾	..	5 2 2
150,000	10	"	6	Do. 6 p.c. Pref.		11⅞—12¼	..	4 18 0
125,000	50	Jan. 2	5	Do. 5 p.c. Deb.		50—51	..	4 18 0
135,000	Stk.	Mar. 14	10	Sheffield A		235—237	..	4 4 5
209,984	"	"	10	Do. B		234—236	..	4 4 9
523,500	"	"	10	Do. C		234—236	..	4 4 9
90,000	10	May 31	7½	South African		8—9	..	8 6 8
6,429,895	Stk.	Feb. 15	5/9/4	South Met., 4 p.c. Ord.		118—120	..	4 11 0
1,895,445	"	Jan. 12	3	Do. 3 p.c. Deb.		78—80	..	3 15 0
209,820	Stk.	Feb. 29	8½	South Shields Con. Stk.		156—158	..	5 7 7
605,000	Stk.	Feb. 15	5/16/8	S'th Suburb'n Ord. 5 p.c.		122—124	..	4 14 0
60,000	"	"	5	Do. 5 p.c. Pref.		117—120	..	4 3 4
117,058	"	Jan. 12	5	Do. 5 p.c. Deb. Stk.		120—122	..	4 2 0
502,310	Stk.	May 15	5	Southampton Ord.		105—107	..	4 13 6
120,000	Stk.	Feb. 15	7½	Tottenham and	A 5 p.c.	144—147	..	4 17 0
483,940	"	"	5⅝		B 3½ p.c.	116½—118½	..	4 14 11
149,470	"	Dec. 29	4	Edmonton	4 p.c. Deb.	90—98	..	4 1 8
182,380	10	June 15	5	Tuscan, Ltd.		8½—8⅝*	..	5 15 11
149,900	10	Jan. 2	5	Do. 5 p.c. Deb. Red.		99—101	..	4 19 0
236,476	Stk.	Feb. 29	5	Tynemouth, 5 p.c. max.		112—114	..	4 7 8
255,636	Stk.	"	6⅞	Wands- worth	B 3½ p.c.	141—144	..	4 15 6
85,766	"	Dec. 29	3		3 p.c. Deb. Stk.	71½—73½	..	4 1 8

Prices Marked * are "Ex Div."

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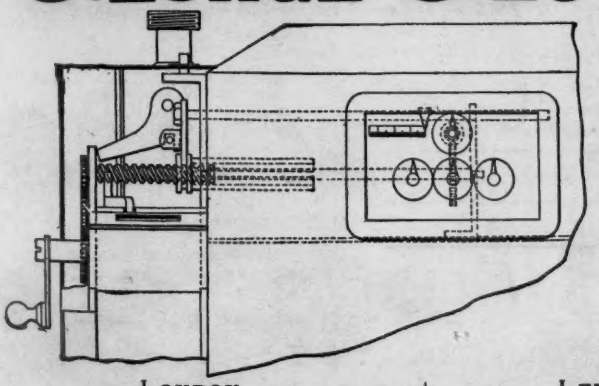

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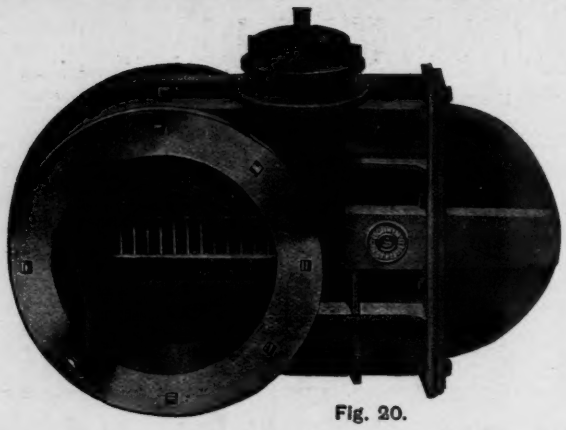

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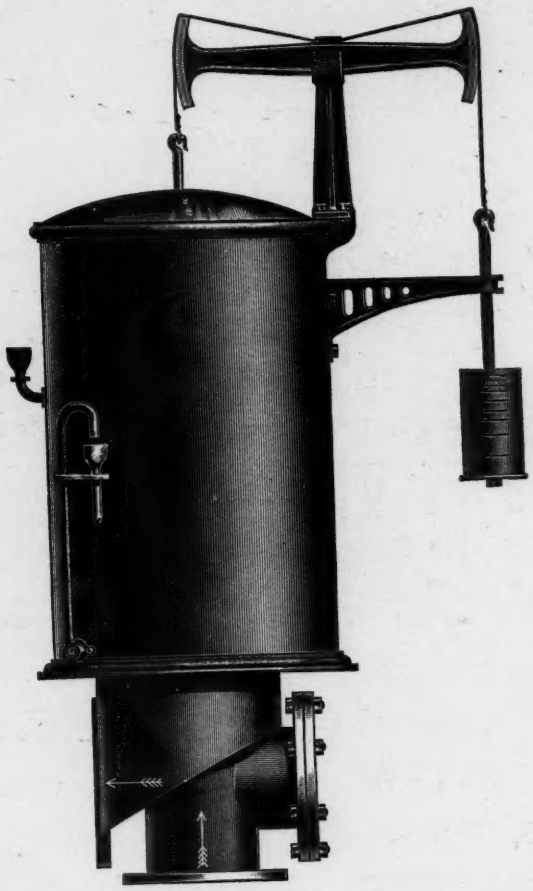

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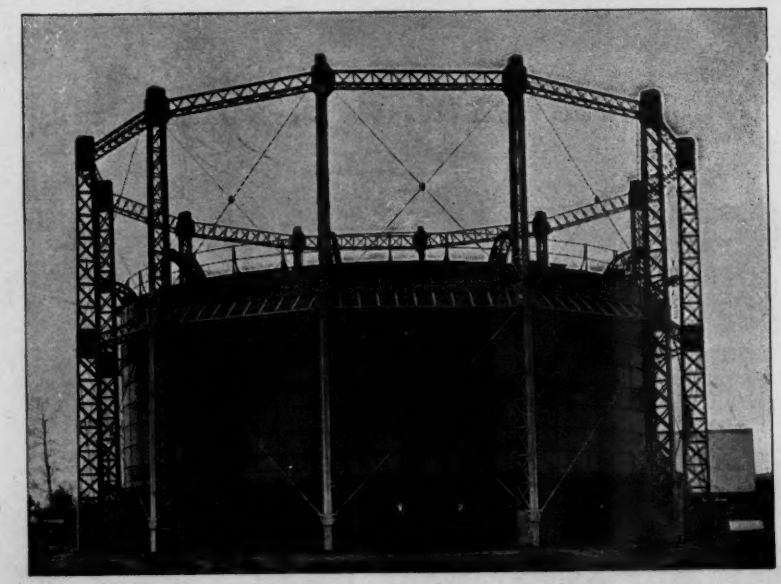

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